September 1996

(REVISED SEPTEMBER 1997)

NAVIGATION STUDY FOR TAMPA HARBOR - BIG BEND CHANNEL - 10128

FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

US Army Corps of Engineers
Jacksonville District
South Atlantic Division

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

Tim M ✓

CECW-PE (10-1-7a)

13 OCT 1998

SUBJECT: Tampa Harbor, Big Bend Channel, Florida

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on the Tampa Harbor, Big Bend Channel, Florida, study of navigational improvements. It is accompanied by the reports of the district and division engineers. These reports are in partial response to House and Senate resolutions dated 14 November 1979 and 29 May 1979, respectively. The resolutions request review of the report of the Chief of Engineers on Tampa Harbor, Florida, House Document 401, Ninety-first Congress, second session, to determine if the authorized project should be modified. The resolutions specify that improving and maintaining the existing local project for Big Bend Channel and the existing Federal project for Alafia River be considered.

2. The reporting officers recommend modifying the Tampa Harbor navigation project to deepen the entrance channel, east channel, and inner channel at Big Bend from 34 feet to 41 feet below mean low water (MLW). The entrance channel would be widened from 200 feet to 250 feet for a length of 1.9 miles. Additionally, the existing turning basin would be deepened to 41 feet MLW and expanded to provide a minimum width of 1,200 feet. An additional 2 feet of depth would be dredged in the channels and turning basin in conjunction with the initial construction for purposes of advanced maintenance. Associated non-Federal facilities include deepening the berthing areas and modifying bulkheads. Approximately 3.5 million cubic yards of dredged material from the initial construction would be placed on Disposal Island 3D. The dikes on Island 3D would be raised approximately 7 feet to accommodate material from the initial construction of the Big Bend project. A future raising of the disposal area dikes on Island 3D would be necessary to accommodate maintenance dredging.. With the authorization of the improvements noted above, the Big Bend channel will become part of the Federal improvements at Tampa Harbor. The plan recommended by the district engineer is the national economic development plan. Preconstruction engineering and design activities for this proposed project will be continued under the resolutions cited above.

3. Project costs are allocated to the commercial navigation project purpose. Based on April 1998 price levels, the estimated cost of the general navigation features (GNF) is $8,918,000. The

GNF costs include dredging of the channels and turning basin and construction of a dredged material disposal facility. In accordance with Section 101 of WRDA 1986, as amended by Section 201 of WRDA 1996, the Federal and non-Federal shares of GNF are estimated to be $5,797,000 and $3,121,000, respectively. In addition, the Federal government would incur the cost of navigational aids currently estimated to be $438,000. Ten percent of the non-Federal share of costs allocated to GNF may be initially Federally funded and repaid to the Federal government over a period not to exceed 30 years. The non-Federal interests may receive credits for the value of lands, easements, rights-of-way, and relocations (LERR) necessary for the Federal project.

4. Non-Federal interests must bear the cost of local service facilities, including dredging berthing areas, providing disposal area capacity to dispose of dredged materials from berthing areas, and modifying bulkheads. The estimated costs of non-Federal responsibilities that are not subject to cost sharing are estimated to be $2,133,000 for bulkhead modifications and $867,000 for berthing area dredging. This $3,000,000 total cost does not include disposal costs associated with berthing area material since the berthing area material will continue to be placed in the currently used private upland facility. Prior to or during initial construction, the non-Federal interests will also be responsible for the cost of the removal of any shoaled maintenance material from the existing Big Bend channel and turning basin. This cost is expected to be minimal since the existing channel is actively maintained to a depth of 36 feet below MLW, which includes 2 feet for advanced maintenance. Pre-condition surveys will be used to determine this non-Federal cost prior to initiation of construction.

5. The total cost for all features required to obtain the projected navigation benefits, including GNF, LERR, local service facilities, and aids-to-navigation are estimated to be $12,356,000. Of this amount, $6,235,000 would be Federal, and $6,121,000 would be non-Federal. The equivalent annual operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) requirements are currently estimated at $295,000, based on maintaining the channels, the disposal site facilities, non-Federal berthing areas, and aids-to-navigation. These costs include future disposal facility improvements at Island 3D for creation of capacity for placement of maintenance materials. These disposal facility improvements would be cost shared as GNF. The equivalent annual OMRR&R costs would be allocated $246,000 Federal ($187,000 for maintenance dredging of the channel and turning basin, $3,000 for maintenance of navigation aids, and $56,000 for disposal facility improvements) and $49,000 non-Federal ($19,000 for maintenance dredging of the berthing area and $30,000 for disposal facility improvements). Island 3D is currently being used as a disposal site for the existing Tampa Harbor project and the estimated maintenance costs are $60,000 annually. Maintenance costs for the improved disposal site are not expected to increase over and above the current amount but will become a Federal responsibility. Average annual benefits and costs, based on April 1998 price levels and an discount rate of 7-1/8 percent, are estimated at $3,830,000 and $1,204,000, respectively, with a resulting benefit-cost ratio of 3.2 to 1.

6. Washington level review indicates that the proposed plan is technically sound, economically justified, and environmentally and socially acceptable. The proposed project complies with applicable U.S. Army Corps of Engineers planning procedures and regulations. Also, the views of interested parties, including Federal, State, and local agencies have been considered.

7. Accordingly, I recommend that the existing Tampa Harbor project be modified to provide navigation improvements generally in accordance with the reporting officers' recommended plan, and with such modifications as in the discretion of the Chief of Engineers that may be advisable. My recommendation is subject to cost sharing, financing, and other applicable requirements of Section 101 of WRDA 1986, as amended by Section 201 of WRDA 1996, for navigation projects. Also, this recommendation is subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including the following requirements:

a. Provide, operate, maintain, repair, replace, and rehabilitate, at its own expense, the local service facilities in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

b. Provide, at no cost to the Government, funds to pay the proportional cost of construction of any dredged material disposal facilities and maintenance thereof, necessary to dispose of dredged or excavated material for the local service facilities during the initial construction of the local service facilities and the operation, maintenance, repair, replacement, and rehabilitation of the local service facilities;

c. Provide all lands, easements, and rights-of-way, including those lands, easements, and rights-of-way required for dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features (including all lands, easements, rights-of-way, and relocations necessary for dredged material disposal facilities);

d. Accomplish all removals determined necessary by the Federal Government other than those removals specifically assigned to the Federal Government;

e. In accordance with Section 201 of the Water Resources Development Act of 1996, provide, during the period of construction, a cash contribution equal to the non-Federal cost share of the project's total cost of construction of the general navigation features, which include the construction of land-based and aquatic dredged material disposal facilities or improvements thereof that are necessary for the disposal of dredged material required for project construction, operation, or maintenance and for which a Federal contract for the facility's construction or improvement was not awarded on or before October 12, 1996;

f. Repay with interest, over a period not to exceed 30 years following completion of the period of construction of the project, up to an additional 10 percent of the total cost of construction of general navigation features depending upon the amount of credit given for the value of lands, easements, rights-of-way, and relocations provided by the non-Federal sponsor for the general navigation features. If the amount of credit exceeds 10 percent of the total cost of construction of the general navigation features, the non-Federal sponsor shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of lands, easements, rights-of-way, and relocations in excess of 10 percent of the total cost of construction of the general navigation features;

g. Provide, or pay to the Federal Government, prior to or during the period of construction, the cost of removal of shoaled maintenance material from the existing Big Bend channel and turning basin which are currently maintained by non-Federal interests at a depth of 36 feet below MLW (when including added depth for advanced maintenance);

h. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the general navigation features for the purpose of inspection, and, if necessary, for the purpose of operating, maintaining, repairing, replacing, and rehabilitating the general navigation features;

i. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project, any betterments, and the local service facilities, except for damages due to the fault or negligence of the United States or its contractors;

j. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total cost of construction of the general navigation features, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and local governments at 32 CFR, Section 33.20;

k. Perform, or cause to be performed, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, maintenance, repair, replacement, or rehabilitation of the general navigation features. However, for lands that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigation unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

l. Assume complete financial responsibility, as between the Federal Government and the non-Federal sponsor, for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features;

m. Agree that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability. To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA;

n. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987, and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

o. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army";

p. Provide a cash contribution equal to the non-Federal cost share of the project's total historic preservation mitigation and data recovery costs attributable to commercial navigation that are in excess of 1 percent of the total amount authorized to be appropriated for commercial navigation;

q. Enter into an agreement which provides, prior to construction, 25 percent of preconstruction engineering and design (PED) costs;

r. Provide during construction, any additional funds needed to cover the non-Federal share of PED costs; and

s. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

8. The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program nor the perspective of higher review levels within the executive branch. Consequently, the recommendation may be modified before it is transmitted to Congress as a proposal for authorization and implementation funding. Prior to transmittal to Congress, we will coordinate any modifications with the Tampa Port Authority, the State of Florida, interested Federal agencies, and other parties, and these parties will be afforded an opportunity to comment further.

JOE N. BALLARD
Lieutenant General, U.S. Army
Chief of Engineers

CESAD-ET-PL (CESAJ-PD-PN/18 Sep 96) (10-1-7a) 1st End
Mr. Meyer/bg/404-331-4326
SUBJECT: Tampa Harbor - Big Bend Channel Feasibility Report and Environmental Assessment

Commander, South Atlantic Division, U.S. Army Corps of Engineers, Room 322, 77 Forsyth Street, SW., Atlanta, Georgia 30303-3490
30 SEP 1996

FOR CDR, HQUSACE, ATTN: CECW-ZA, WASH DC 20314-1000

I concur in the recommendation of the District Engineer to authorize construction of navigation improvements to the non-Federal Big Bend Channel, Tampa Harbor, Florida, with subsequent Federal maintenance of the channel.

Encl

R. L. VANANTWERP
Brigadier General, USA
Commanding

DEPARTMENT OF THE ARMY
SOUTH ATLANTIC DIVISION, CORPS OF ENGINEERS
ROOM 322, 77 FORSYTH ST., SW
ATLANTA, GEORGIA 30303-3490

September 30, 1996

NOTICE OF COMPLETION
Feasibility Report
Tampa Harbor - Big Bend Channel
Tampa, Florida

COMPLETION OF STUDY

Notice is hereby given that the Jacksonville District and the South Atlantic Division Engineers have completed a final feasibility report and environmental assessment for navigation improvements to the Big Bend Channel, Tampa Harbor, Florida. This report was prepared in partial response to resolutions of the Committee on Public Works and Transportation of the United States House of Representatives dated 14 November 1979 and the Committee on Environment and Public Works of the United States Senate dated 29 May 1979. A Finding of No Significant Impact (FONSI) statement accompanies the report.

FINDINGS AND RECOMMENDATIONS

The report recommends authorizing construction of navigation improvements to the non-Federal Big Bend Channel and subsequent Federal maintenance of the channel. These improvements consist of deepening the Big Bend entrance channel, turning basin, and inner channel from 34 to 41 feet and widening the entrance channel from 200 to 250 feet. The report also recommends authorizing removal of any excess dredged material from Disposal Island 3D for beneficial uses according to any plans to be developed under the authority of Section 204 of the 1992 Water Resources Development Act (Public Law 102-580).

Based on October 1995 prices, estimated first cost of the plan is $11,283,000, of which $4,853,000 would be the Federal share while $6,430,000 would be the non-Federal share. Average annual benefits and costs based on an interest rate of 7 5/8 percent are estimated at $3,729,000 and $1,127,000 respectively with a resulting benefit-cost ratio of 3.3.

The recommendations contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program nor the perspective of higher review levels within the Executive

Branch. Consequently, the recommendations may be modified before they are transmitted to the United States Congress as a proposal for authorization and/or implementation funding.

COORDINATION

The report has been coordinated with concerned local interests and the responsible state and Federal agencies. The Final Coordination Act Report from the U.S. Fish and Wildlife Service is included in the report.

The Tampa Port Authority is the project sponsor and by letter dated 9 September 1996, expressed support for the project and their intent to secure funding for project implementation.

PUBLIC INVOLVEMENT

The draft feasibility report was circulated for public review during August 1996 and comments provided during this review are incorporated in the report.

REVIEW AND AUTHORIZATION PROCESS

Prior to adoption of the proposed project, the study evaluations and report findings will be reviewed by the Chief of Engineers and the Assistant Secretary of the Army for Civil Works. A coordinated review, including the state of Florida and other Federal agencies, will also be accomplished at that time. The Chief of Engineers will review the report and forward a recommendation to the Secretary of the Army.

If the recommendation of the Chief of Engineers is significantly different from the recommendation coordinated with the state of Florida and Federal Agencies, interested parties will be afforded an opportunity to comment further prior to submission of the Chief's report to the Secretary. The Assistant Secretary of the Army, in consultation with the Office of Management and Budget, then establishes the Administration position on whether the proposal should be recommended to Congress for authorization.

VIEWS OF INTERESTED PARTIES

Interested parties may present written views on the report to the Chief of Engineers and the Secretary of the Army through the Policy Review Branch. Such communications should be mailed to the Policy Review and Analysis Division, ATTN: CECW-AR, 7701 Telegraph Road, Alexandria, Virginia 22315-3861, in time to reach the Policy Review Branch within 30 days from the date of this notice. Copies of information received by mail will be regarded as public information unless the correspondent requests otherwise. Such a request will limit the usefulness of the information because of the need for full public disclosure of all factors relevant to the decision on project approval.

FINAL ACTION BY THE CHIEF OF ENGINEERS

The Chief of Engineers will not submit a recommendation to the Secretary on the report until after the expiration of this notice or any extension thereof that may be granted, and full consideration of all information submitted in response thereto.

REPORT INFORMATION

Further information concerning the study and report may be obtained from the District Engineer, Jacksonville. Requests should be addressed to the District Engineer, U.S. Army Engineer District Jacksonville, P.O. Box 4970, Jacksonville, Florida 32232-0019. The report may be viewed by interested parties at the above office. Interested parties may purchase copies of the report at the cost of reproduction ($22.00). Checks or money orders should be made payable to the Finance and Accounting Officer, U.S. Army Engineer District, Jacksonville.

Please pass along a copy of this public notice to anyone who may be interested in the report and who has not received a copy.

R. L. VanAntwerp
Brigadier General, U.S. Army
Division Engineer

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

TAMPA HARBOR - BIG BEND CHANNEL, FLORIDA

FEASIBILITY REPORT AND

ENVIRONMENTAL ASSESSMENT

SYLLABUS

The Tampa Port Authority agreed to sponsor a study of Big Bend Channel and Alafia River. A United States House Committee Resolution adopted November 14, 1979, authorized the study and this report. The Alafia River portion of the study is a single owner situation, and the U.S. Army Corps of Engineers policy does not support improvements to benefit one owner. The feasibility study excluded Alafia River from further consideration. The study findings in this report are only for the Big Bend Channel portion.

The Big Bend Channel study considered engineering, economic, and environmental alternatives in deciding on a plan for improving navigation. The evaluations considered enlarging the channel bottom area as well as deeper depths over that area. Model simulation studies concluded that widening the existing entrance channel from 200 to 250 feet was necessary. That model also indicated a need to enlarge the turning basin for vessels changing direction between the entrance and inner channels. The inner channel and east channel increments of the project remain at an existing bottom width of 200 feet. Depth considered for the channel bottom area ranged from 36 to 46 feet. The selected depth from economic analysis is 41 feet. The total first cost of the navigation project is $11,348,000 and the total economic first cost is $11,398,000. The Federal share of the total first cost is $5,747,000 which includes navigation aid costs of $438,000. The sponsor's share is $5,601,000 which includes berth deepening and bulkhead modification costs.

Economic analysis determined the average annual equivalent (AAEQ) values for benefits and costs. The benefits are from transportation savings in the movement of coal, phosphate rock, and phosphate chemicals. The AAEQ benefits are about $3,729,000. The AAEQ costs include interest and amortization of the total first costs along with periodic maintenance dredging and disposal costs at an interest rate of 7.625 percent. That cost is an estimated $1,211,000. The benefit-to-cost ratio is 3.1 to 1.

An update of the economics and costs was completed in May 1998. Revised AAEQ benefits are $3,830,000. The revisions were based upon the current 1998 interest rate of 7.125 percent. The total project construction cost based on April 1998 prices is now estimated at $12,356,000. The Federal share of the construction cost is estimated to be $6,235,000 and the non-Federal share is estimated to be $6,121,000. The revised AAEQ costs which include interest and amortization of the total first costs along with periodic maintenance dredging and disposal costs at an interest rate of 7.125 percent. That cost is an estimated $1,204,000. The benefit-to-cost ratio is 3.2 to 1.

The study also explored the use of dredged material for environmental benefits. The estimated high fines content in the dredged material makes it unsuitable for direct deposit in an unconfined area. A beneficial use plan was not possible to do along with the proposed navigation project. The process to obtain suitable material for beneficial use involved placement of all excavated quantities first into disposal island 3D. That initial step enables the separation of fines from coarser grain materials within the disposal area. Material, not needed for dike construction, would be available for use in projects to benefit the environment. Consideration of a project for use of that material is more appropriate at some future date using an available authorization process to determine the most feasible plan.

SELECTED/NED PLAN COST SHARING
(April 1998 Price Level)

ITEM	TOTAL COST (000)	FEDERAL SHARE (000)	NON-FEDERAL SHARE (000)
General Navigation Features (GNF)			
Channels and Turning Basin	$5,248	$3,411 1/	$1,837 2/
Environmental Monitoring	92	60	32
Dike and weir construction	2,249	1,462	787
Preconstruction Eng & Design	591	384	207
Construction Management	738	480	258
Subtotal, GNF Costs	$8,918	$5,797	$3,121
Features not Cost Shared			
Berthing Areas 3/	$768	0	$ 768
Preconstruction Eng & Design	44	0	44
Construction Management	55	0	55
Subtotal, Berthing Areas	$867	0	$867
Bulkhead Modification 3/	2,133	0	2,133
Navigation Aids	438	438	0
TOTALS	$12,356	$6,235	$6,121

NOTES:
1/ The estimated Federal share of general navigation features is 65 percent. The non-Federal sponsor has no estimated credit.
2/ Non-Federal sponsor cost is a 25 percent cash contribution plus 10 percent over 30 years for a total of 35 percent of the general navigation features.
3/ Berthing areas dredging and bulkhead modifications are 100 percent non-Federal expenses. Also included is a user fee of $222,000 to use disposal area 3D for placement of berthing area material.

SELECTED/NED PLAN COST SHARING
(April 1998 Price Level)

COST ACCOUNT/DESCRIPTION	TOTAL COST (000)	FEDERAL SHARE (000)	NON-FEDERAL SHARE (000)	FULLY FUNDED COST (000)	FEDERAL SHARE (000)	NON-FEDERAL SHARE (000)
12 DREDGING	$ 10,928	$5,317	$5,557	$ 11,678	$ 5,780	$ 5,898
Channels and Turning Basin	5,248	3,411	1,837	5,618	3,689	1,929
Environmental Monitoring	92	60	32	98	64	34
Navigation Aids	438	438	0	468	468	0
Disposal Areas	2,249	1,462	787	2,399	1,559	840
Berthing Areas	768	0	768	819	0	819
Bulkhead Modification	2,133	0	2,133	2,276	0	2,276
30 PLANNING, ENGINEERING AND DESIGN	$ 635	$ 384	$ 251	$ 658	$ 397	$ 261
Engineering & Design Complete	258	168	90	258	168	90
Engineering & Design	333	216	117	353	229	124
Engineering & Design (100% Non-Fed)	44	0	44	47	0	47
31 CONSTRUCTION MANAGEMENT	$ 793	$ 480	$ 313	$ 864	$ 523	$ 341
Construction Mgmt	738	480	258	804	523	281
Construction Mgmt (100 % non-Fed)	55	0	55	60	0	60
TOTALS	$12,356	$6,235	$6,121	$13,200	$ 6,700	$6,500

SUMMARY COMPARISON OF SELECTED PLAN BENEFITS AND COSTS

ITEMS	41 Feet
AAEQ Benefits	$3,830,000
Costs – Interests and Amortization 1/	909,000
Maintenance: Channel shoals 2/	206,000
Navigation aids	3,000
Disposal area costs 3/	86,000
Total AAEQ costs	$1,204,000
Benefit-to-cost ratio	3.2 to 1

NOTES:

1/ The total first cost ($12,356,000) plus IDC of $50,000 is the total economic cost for the project. That economic cost is then amortized over 50 years at an interest rate of 7.125 percent for the AAEQ cost for all channels (including Advanced Maint), turning basin, bulkhead modifications, berthing areas, and 7 feet of dike on disposal area 3D. During project construction, an additional 3 feet (above the 7 feet required for construction) will be constructed for maintenance at a cost of $1,906,000. The Big Bend Share is $423,000. This first cost is from the updated project cost estimate.

2/ Annual costs for maintenance to remove shoals include the excavation of material from the project channels, turning basin, and berthing areas with placement in disposal island 3D. Includes removal of 720,000 cy of material every nine years for the 50 year project life. Each maintenance event is estimated in current dollars at $2,517,000. The present worth of all of the maintenance events on 9 year cycles is $2,587,000. The present worth spread out over 50 years at 7.125% is $206,000. The Non-Federal portion of the cost is $19,000 for berthing area maintenance. The Federal portion is $187,000 for channel and turning basin maintenance.

3/ Average annual costs for disposal include the Big Bend Share (22.2%) of all dike improvements at Disposal Island 3D. In project year 7, an additional 10 feet of dike will be construction for maintenance at a cost of $7,729,000. The Big Bend Share is $1,716,000. The Present Value of $1,716,000 at 7.125% is $1,060,000 which is the total first cost of the Big Bend Share. The AAEQ of $1,060,000 at 7.125% over a 30 year life is $86,000. The non-Federal cost sharing is 35 percent of the $86,000 or $30,000. The Federal cost is 65 percent or $56,000.

TAMPA HARBOR - BIG BEND CHANNEL, FLORIDA
FEASIBILITY REPORT AND
ENVIRONMENTAL ASSESSMENT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

The Big Bend navigation features are now privately maintained to serve two land owners. Those owners handle phosphate rock and phosphate chemicals as well as coal for electric power generation. The Tampa Port Authority also owns land in the area with potential for future terminal development. The depth of the channels, berths, and turning basin is presently about 34 feet[1]. The entrance and inner channel widths are about 200 feet. The irregularly shaped turning basin has a turning diameter of about 1,000 feet.

A reconnaissance report was completed in 1980 that recommended further study for both Big Bend Channel and Alafia River. The following feasibility report recommended channel widths of 300 feet and depths of 43 feet for both Alafia River and Big Bend Channel. The feasibility report was submitted to the Board of Engineers for Rivers and Harbors in 1985 but was returned at the sponsor's request. Another reconnaissance report was prepared in 1991 which recommended further study of only Big Bend Channel. Alafia River was found to be a single owner situation and no further study was recommended for that portion. A Feasibility Cost Sharing Agreement (FCSA) was negotiated and executed in 1992 for a feasibility level study of Big Bend Channel. This report is the culmination of that study.

AUTHORITY

The present study is authorized by Senate and House Resolutions adopted 29 May 1979 and 14 November 1979, respectively. The content of the resolutions is as follows for the study area shown on figure 1:

"Resolved by the committee on Public Works and Transportation of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Tampa Harbor, Florida, printed in House Document No. 401, Ninety-First Congress, Second Session, and other pertinent reports, with a view of determining if the authorized project should be modified in any way at this time, with particular reference to improvement and maintenance of the existing local project for Big Bend Channel and the existing Federal project for Alafia River." and

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1 All depths in this report are referenced to mean low water except where stated otherwise.

"Resolved by the committee on Environment and Public Works of the United States Senate, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Tampa Harbor, Florida, printed in House Document No. 401, Ninety-First Congress, Second Session, and other pertinent reports, with a view of determining if the authorized project should be modified in any way at this time, with particular reference to improvement and maintenance of the existing local project for Big Bend Channel and the existing Federal project for Alafia River."

PURPOSE AND SCOPE

The Tampa Port Authority (TPA) is the sponsor for the recommended modifications to the existing project at Big Bend Channel. The purpose of this study is to consider the feasibility of further modifying the existing private navigation project for Big Bend Channel. Particular emphasis is placed on deepening and widening the existing channel to safely accommodate the existing and prospective vessel fleet. The channel provides access to the authorized 43-foot Tampa Harbor Main Shipping Channel. This report provides the results of investigations to determine the Federal interest and feasibility of project construction. The selected solution from that investigation is in concert with current policies for navigation improvements to the existing project at Big Bend Channel.

PRIOR STUDIES AND REPORTS

A second reconnaissance report on Big Bend Channel and Alafia River was completed in 1991. The recommendation in that report was only for more detailed study of the Big Bend Channel. This feasibility report contains the results of that study. The only other study and report on Big Bend Channel was in conjunction with the Alafia River. That report went to the Board of Engineers for Rivers and Harbors in 1985. That Board returned the report at the local sponsor's request.

The first favorable report for the Alafia River, contained in Senate Document 16, 77th Congress, First Session, recommended a channel 150 feet wide and turning basin to a depth of 25 feet in Alafia River. The second favorable report in House Document 258, 81st Congress, First Session, recommended a channel 200 feet wide and turning basin 700 feet by 1200 feet both to a depth of 30 feet in Alafia River. The River and Harbor Acts of 2 March 1945 and 17 May 1950, respectively, authorized those projects.

Numerous studies have been made on the existing Tampa Harbor project; the latest report is in House Document 91-401, 91st Congress, First Session, and the most recent Congressional project authorization is in the River and Harbor Act of 31 December 1970.

EXISTING PROJECTS

The existing Federal project in the study area is Tampa Harbor. The Tampa Harbor project provides a channel depth of 43 feet to phosphate terminals located in Hillsborough Bay (see figure 1). Alafia River is an existing Federal project as part of the Tampa Harbor project. As authorized, Alafia River has a channel depth of 30 feet water over a bottom width of 200 feet from the ship channel in Hillsborough Bay to and including a turning basin 700 feet wide and 1,200 feet long in Alafia River. The project length is about 3.6 miles.

Big Bend Channel is a privately constructed and maintained channel 34 feet deep by 200 feet wide from the main ship channel in Hillsborough Bay to and including a turning basin 1,000 feet long by 700 to 1,500 feet wide. The length of the project is about 2.2 miles (see figure 2).

EXISTING CONDITIONS

The navigation features at Big Bend consist of an entrance channel, turning basin, inner channel, and berthing areas. Private interests dredged a channel to provide access from the Tampa Harbor Main Ship Channel to the facilities in southeast Hillsborough County. Excavation began in 1967 to provide a channel 34 feet deep and 200 feet wide with dredged material going into a private upland area. Construction also included a turning basin and inner channel with project completion in 1969. Since construction, area interests have maintained the project with shoal material going into private upland areas.

PORT BERTHS AND TERMINAL FACILITIES

The general location of facilities at Big Bend are on figure 3. Those terminals enable the unloading of coal and the loading of phosphate rock, processed phosphate chemical, and phosphoric acid. Coal and phosphate rock are the major commodities. The coal terminal is on the southern end of the inner channel next to the coal-fired power plant (see figures 2 and 4). The phosphate loading terminal is on the south side of the channel that is off the eastern end of the turning basin. The sponsor has 150 acres of undeveloped land along the north side of that channel in the Port Redwing area.

The terminal in figure 4 handles integrated tug-barge movements of coal. Useable wharf length at that terminal is about 1,100 feet with berth depths of 34 feet. The terminal has two overhead cranes, ladder and bucket type, for unloading coal from the barges. Each of those cranes has an unloading rate of about 2,000 short tons per hour. The coal moves on a conveyor to one of three storage areas in the figure. Those areas have a total static capacity of about 750,000 to 830,000 short tons depending on the coal density.

The phosphate rock terminal in figure 5 has 2,500 feet of usable wharf length with an adjacent berth depth of 34 feet. Phosphate rock and chemical or phosphoric acid can be loaded at any station along the berths. Storage facilities include six phosphoric acid tanks which can hold 60,000 short tons. The enclosed, dry storage area for phosphate chemicals holds 32,000 short tons. Storage of phosphate rock is in an open area with a capacity of about 2,200,000 short tons. Facilities are open to all on equal terms for movement of those specific commodities.

TRIBUTARY AREA

The primary commodities to be considered in the benefit analysis are phosphate rock, phosphate chemicals, and coal. The phosphate rock or ore comes primarily from mining operations in Polk County. The phosphate chemicals come from processing plants near the mines in Polk County. The phosphate terminal facility at Big Bend handles mainly wet phosphate rock and phosphate chemicals, Granulated Triple Super Phosphate (GTSP) and phosphoric acid. The coal facility unloads coal which comes mainly from a trans-shipment point at Davant, Louisiana.

The phosphate has different destinations and modes of transport. Wet phosphate rock goes into barges for transport to Donaldsonville and Uncle Sam, Louisiana. Granulated Triple Super Phosphate (GTSP) moves by barge to Davant, Louisiana, and by ocean going vessel to ports world-wide. Phosphoric acid is a liquid requiring tank storage for movement. Movement is mainly by ocean going vessels to ports primarily in the Far East, Central America, and South America.

To comply with Clean Air Act Amendments of 1990, blending of low sulfur coals with current fuels is necessary at Big Bend. The various sources of coal come to the Electrocoal facilities at Davant, Louisiana, where they are trans-shipped to Tampa Harbor. Those sources are both domestic and foreign. The electric plants in the Tampa area convert coal to electricity that goes to over 491,000 customers in an area of about 2,000 square miles. That area includes most of Hillsborough County and parts of Pinellas and Polk Counties with a total population of over 1 million.

SOCIO-ECONOMIC STATISTICS

Population projections of the Bureau of Economic Analysis regional area for the years 1995 - 2020 are given in table 1. Population projections are as reported in the Florida Statistical Abstract by the Bureau of Economic and Business Research, College of Business Administration, University of Florida (1994). Population in 1990 is from the April 1990 Census.

TABLE 1

POPULATION PROJECTIONS
TAMPA-ST. PETERSBURG REGIONAL AREA

COUNTY	1990	1995	2000	2005	2010	2015	2020
Charlotte	110,975	130,400	153,600	176,200	198,600	221,300	243,800
Citrus	93,513	106,800	123,100	138,800	154,400	170,100	185,700
Collier	152,099	187,600	222,200	256,000	289,500	323,400	357,100
De Soto	23,865	26,300	28,500	30,700	32,800	34,900	36,900
Hardee	19,499	22,300	23,100	23,800	24,500	25,200	25,800
Hernando	101,115	120,600	144,500	168,000	191,300	215,100	238,700
Highlands	68,432	78,500	85,400	94,000	102,400	110,900	119,200
Hillsborough	834,054	892,300	962,300	1,028,800	1,093,100	1,156,800	1,218,600
Lee	335,113	376,600	428,100	478,000	527,200	576,700	625,600
Manatee	211,707	232,700	257,400	281,100	304,300	327,500	350,200
Pasco	281,131	306,400	340,100	372,400	403,900	435,500	466,400
Pinellas	851,659	879,800	919,500	958,100	996,200	1,033,800	1,070,300
Polk	405,382	443,900	481,200	517,000	551,800	586,500	620,400
Sarasota	277,776	301,200	329,800	357,000	383,500	409,800	435,400
TOTAL	**3,766,320**	**4,103,400**	**4,498,800**	**4,879,900**	**5,253,500**	**5,627,500**	**5,994,100**

COMMODITIES

Commodity tonnage that moved over the Big Bend Channel in the past 20 years has experienced accelerated growth. During the first full year of operation in 1970, the channel had 302,000 tons of cargo as shown in table 2. The total tonnage in 1990 was 10,500,000 tons. Table 2 shows the development of tonnage by the various commodities from 1970 to 1994 on that channel. Appendix B provides more discussion and information concerning the commodity movements.

Phosphate Rock. Tug/barge units move the majority of phosphate rock from Big Bend to Donaldsonville or Uncle Sam, Louisiana. When Freeport/McMoran purchased Agrico Inc. in 1988, the operation became larger with the movement of Freeport/McMoran's operation from the East area in Tampa to Big Bend. The Big Bend terminal then went from loading on a standard 5 day week to a 7 day week, 24 hours a day. Table 2 shows the tonnage change and breakdown by commodity.

Coal. As electric demand increased and more generating capacity was added to the plant at Big Bend, table 2 shows an overall growth in coal movements. Nearly all of the coal arrives from Davant, Louisiana by tug/barge units. Since 1970, only one shipment by self-propelled bulk carriers moved coal from another source to the terminal at Big Bend.

Phosphate Chemical. Self-propelled bulk carriers normally transport Granular Triple Super Phosphate (GTSP) and Di-ammonium Phosphate (DAP) from Big Bend to destinations throughout the world. GTSP amounts generally show an overall growth with yearly fluctuations. Chemical tankers transport phosphoric acid to destinations in South and Central America, the Caribbean, and U.S. ports. Integrated tug/barge units transport phosphate chemicals mainly to Donaldsonville which is just upstream from Davant, Louisiana.

TABLE 2

COMMODITY HISTORY
(1,000 SHORT TONS)

YEARS	COAL	PHOSPHATE ROCK	GTSP	PHOSPHORIC ACID	MISC.	TOTAL
1970	301.7	0	0	0	0	**301.7**
1971	658.0	0	0	0	0	**658.0**
1972	1,216.1	0	0	0	0	**1,216.1**
1973	1,540.6	0	0	0	0	**1,540.6**
1974	1,826.7	0	0	0	4.8	**1,831.5**
1975	1,707.2	436.4	0	2.2	0	**2,145.8**
1976	2,216.6	1,295.5	122.6	89.7	0	**3,724.4**
1977	2,385.8	2,417.3	215.9	121.6	12.8	**5,153.4**
1978	2,551.5	2,725.0	352.4	156.2	23.1	**5,808.2**
1979	2,439.1	2,917.5	280.7	181.3	21.9	**5,840.5**
1980	2,429.5	2,847.0	320.3	177.1	10.2	**5,784.1**
1981	3,241.9	2,426.1	344.5	193.8	0	**6,206.3**
1982	2,870.9	2,115.6	244.6	212.7	0	**5,443.8**
1983	3,239.0	2,380.8	449.6	193.3	0	**6,262.7**
1984	3,196.0	2,755.4	381.3	309.4	0	**6,642.1**
1985	4,167.9	3,005.4	576.8	361.9	4.9	**8,116.9**
1986	3,390.2	2,704.9	441.1	269.8	25.0	**6,831.0**
1987	4,431.5	2,640.6	623.2	236.9	17.7	**7,949.9**
1988	4,507.2	3,732.6	514.8	313.9	18.5	**9,087.0**
1989	4,178.3	5,628.4	472.8	321.4	24.3	**10,625.2**
1990	4,160.9	5,683.4	490.2	218.8	44.0	**10,597.3**
1991	4,053.1	5,743.2	517.2	81.8	9.0	**10,404.3**
1992	4,442.7	5,537.5	562.7	164.8	0	**10,707.7**
1993	**4,659.6**	**4,336.8**	**559.7**	**255.2**	**0**	**9,811.3**

SOURCE: Tampa Port Authority

TAMPA HARBOR HISTORIC DREDGED VOLUMES

The Tampa Port Authority has a draft maintenance dredging disposal plan (1994) for Tampa Harbor. That plan was a source of historic data and potential projections for future maintenance dredging associated with the study area. Development data in appendix F, the dredged material management plan, came primarily from that document. An analysis of past construction and maintenance work provides a setting for future dredging and disposal efforts.

The Port Authority's maintenance disposal plan indicates material removed from the main ship channel in the study area amounted to about 32,500,000 cubic yards (CY) between 1978 to 1994. That plan used the year 1978 as a reference point based on availability and accuracy of data from that year. Since construction of disposal islands 2D and 3D around 1980, about 8,000,000 CY of maintenance and 1,000,000 CY of construction material have gone into the islands from dredging.

ALAFIA RIVER AND BIG BEND CHANNEL DISPOSAL SITES

Historically, disposal of dredged material from the Alafia River and Big Bend navigation projects involved only about five upland locations on the mainland. No dredged material went into disposal islands 2D or 3D which are primarily for the Tampa Harbor main ship channel. Only two of those upland locations had a significant amount of remaining capacity prior to 1994 and both are in private ownership. One is near Alafia River and is for maintenance of that project. The other is in the vicinity of Big Bend.

A 67-acre disposal site, located north of Alafia River, is in private ownership. It had about 600,000 CY of capacity prior to 1994. That site is exclusively for the disposal of dredged material from the Alafia River Channel and Turning Basin. Maintenance and deepening of the authorized ship channel on Alafia River in 1994-1995 resulted in the filling of that area to capacity.

The disposal area under private ownership at Big Bend has an estimated capacity of about 650,000 CY in 1996. That site is exclusively for disposal of dredged material from the private ship channels, basin, and berthing areas in the vicinity of Big Bend.

DISPOSAL ISLANDS 2D AND 3D CAPACITIES

The creation of disposal islands 2D and 3D was part of the Federal deepening of the Tampa Harbor navigation project in 1978 to 1982. Since construction, about 6,021,000 CY of dredged material has gone into 2D and 1,896,000 CY into 3D. Surveys in 1990 indicated the remaining capacities in 2D and 3D were about 4,018,000 and 3,614,000 CY, respectively. The dike elevation at the time of the survey was about 20 feet above mean low water and has remained at that height during this study. Placement of dredged material from 1990 to 1994 involved maintenance work on ship channels and berths and amounted to about 2,252,000 CY into 3D and 893,000 CY into 2D. Remaining capacities at the beginning of 1994 were about 1,362,000 CY in 3D and 3,125,000 CY in 2D.

BIG BEND MAINTENANCE AND DISPOSAL AREA

The estimated average shoaling rate on the existing navigation channel at Big Bend is about 60,000 CY a year. Completion of the most recent maintenance to remove shoals occurred in 1994. The after dredging survey is in appendix A. That survey information on depths was the basis for estimating quantities to improve depths and widths on the existing project. That maintenance work involved a required depth of 34 feet with an allowable overdepth of 2 feet. The dredged material from that maintenance went into a private upland site. Available information from the area indicates a private upland disposal area existed in 1995 with an estimated 650,000 CY of remaining capacity for disposal of dredged material.

VESSEL FLEET

The existing fleet of vessels currently using the Big Bend navigation project consists of integrated tug/barge units, self propelled bulk carriers, and self propelled chemical tankers. The vast majority of cargo movement is via barge to and from destinations on the Mississippi River. The integrated tug/barge units range in size from about 700 to 800 feet with beams of 85 feet and drafts up to 36 feet. Typical barges in the fleet are in table B-3 of appendix B. The bulk carriers range up to 740 feet in length and 106 feet in beam with maximum drafts of 41 feet. Drafts and beams of the tankers are comparable to the bulk carriers, with slightly shorter lengths. More information on the self-propelled ships in appendix B, tables B-26, B-30, B-58, and B-76.

FUTURE CONDITIONS
WITHOUT NAVIGATION IMPROVEMENTS

The focus of the analysis on future conditions was mainly on the cargo movements at the Big Bend facilities and maintenance of the channels and berths serving the terminals. The cargo movements involve tonnage and vessels. Appendix B provides the projections of tonnage and vessel fleets to handle the movement of cargo. Appendix F provides a dredged material management plan for disposal of material in the upper Tampa Bay area involving the use of disposal islands 2D and 3D.

PORT CARGO TONNAGE

The prospective tonnages involve coal, phosphate ore, and phosphate products. The phosphate products are granulated triple super-phosphate (GTSP) and phosphoric acid. Steady increases in tonnage for coal, phosphate ore, and GTSP are likely into the future. The U.S. Department of Interior's Bureau of Mines provided information for the projection of phosphate related commodities. Appendix B provides a more detailed discussion which further explains the commodity projections.

Coal. Projected shipments relate to population which has risen steadily. Movements in 1990 were about 4.16 million tons[2] and 4.66 million tons in 1993. The estimate of projected tonnage in appendix B, table B-2, shows a leveling off in 2007 at about 5.96 million tons for the foreseeable future.

Phosphate Ore. Shipments of phosphate ore dominates the tonnage movement now from the phosphate terminal. Estimates for the near future are in appendix B, table B-29. Shipments of about 5.5 million tons in 1994 are likely to have only a slight annual growth to about 7.4 million tons in the year 2017. The forecast beyond that year is a gradual decline in tonnage to zero by the year 2029.

Phosphoric Acid. Shipments of phosphoric acid started in 1975. The product is a chemical liquid. As shown in tables 2 and B-75 in appendix B, records of past shipments show a very irregular annual tonnage over the years. The overall tonnage from 1977 to 1993 averages about 221,800 tons. No increase in that overall average annual tonnage is foreseeable in the near future for that product.

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2 Tonnage measurements in this report are in short tons unless otherwise stated.

Granulated Triple Super Phosphate (GTSP). Tables 2 and B-45 in appendix B show GTSP tonnage beginning about 1976. Annual amounts have been somewhat irregular but overall have generally shown an increase through the years. Current estimates are for a gradual growth from about 530,000 tons in 1994 to about 713,000 tons in the year 2017. The fore-cast beyond that year is for a gradual decline in tonnage to zero by the year 2029.

FUTURE VESSEL FLEET MOVEMENTS

Projections for the vessel fleets are in appendix B and involve the use of bulk vessels to move cargo. Those vessels include deep draft barges and ships. Table references from that appendix provide the vessels sizes and tonnage distributions associated with the prospective fleet.

Coal Vessels. Barges are likely to handle most of the coal. Tables B-2 in appendix B shows the distribution between deep draft barge and self-propelled bulk carriers. Table B-3 shows the size barge which range from about 17,500 to 39,700 deadweight tons (DWT metric). Tables B-5 through B-11 show the barge tonnage relationship without improvement at a depth of 34 feet. The remaining coal movement is on self-propelled ships. Tables B-26 through B-28 show the without improvement depth of 34 feet for that portion of the movement.

Phosphate Vessels. Ore shipments in table B-29 move mainly on barges of about 23,100 to 39,700 DWT metric. Table B-30 provides the barge fleet characteristics. Tables B-31 through B-37 in appendix B show the distribution of tonnage for the without improvement depth of 34 feet. Granulated triple super-phosphate (GTSP) projections in table B-45 move by both deep draft barges and ships. Barge movements are in tables B-47 through B-53. Self-propelled carriers are in tables B-58 through B-74. The total shipment of GTSP is about equally distributed between barge and ship. Most of the phosphoric acid movements are on self-propelled bulk carriers of 10,000 to 20,000 DWT. Table B-75 shows the distribution between foreign and domestic. Tables B-76 through B-83 have the without improvement analysis at a depth of 34 feet.

TERMINAL FACILITIES

Current operations are likely to continue without improvements to existing navigation conditions. Loading and unloading facilities are in good condition and with proper maintenance are likely to remain that way for the near future without significant modification. The only change that could occur is with the Port Redwing property to the north of the phosphate rock and chemical loading facilities.

The Tampa Port Authority recently acquired about 150 acres, adjacent to the east channel in Port Redwing, for development. The port authority is promoting the area as a prime maritime/industrial site. The potential for future development exists with or without improvement.

BIG BEND DISPOSAL AREA

The existing navigation channel at Big Bend has an estimated shoaling rate of about 60,000 CY a year. Without any improvements proposed in this report, that shoal material is likely to continue at about the same average rate. Disposal will likely continue into the private upland site. That existing site would enable dredging and disposal operations for about 10 years of maintenance. At the end of that period, private interests in the area would have to review available options such as seeking other upland sites, reuse existing disposal sites, or negotiate with the Tampa Port Authority to use disposal island 3D.

DISPOSAL ISLANDS 2D AND 3D

The Tampa Port Authority needs to raise the dikes in disposal islands 2D and 3D for future maintenance of the Tampa Harbor navigation project. Both disposal islands have dikes now at an elevation of about 20 feet above mean low water. At that elevation, the remaining capacity in 1994 for 2D and 3D is about 3,125,000 CY and 1,362,000 CY, respectively. Based on subsurface conditions, the maximum dike elevation on disposal island 3D is 40 feet above mean low water (mlw). The area within disposal island 2D has two cells separated with a dike. The northern portion has the potential for a dike height of 40 feet above mlw. The southern portion has the potential for a dike height of only 25 feet above mlw.

Disposal Island 3D. Material for a maximum dike elevation does not exist on disposal island 3D. To add another 20 feet to the dike height requires about 3.34 million CY of suitable construction material. To make repairs to the existing dike requires about 35,000 CY. Only 1.7 million CY of material exists on the island for dike construction. The remaining material needs to come from another source. Maintenance in the near future is likely to provide a small amount of the required material.

Increasing the dike height with material from inside disposal island 3D adds capacity. Using the existing good material within the area to raise the dike and do repairs could help add capacity for future use. A 20-foot increase in dike height adds about 8,600,000 CY without considering the material used from inside the dikes (1.7 million CY) or existing capacity within the area (1.36 million CY). The estimated combined capacity using the existing capacity with the amounts from potential dike increases and removal of inside material is about 11.7 million CY.

Excluding the shoal material from the navigation channels at Alafia River and Big Bend, the average annual maintenance material for placement in disposal island 3D is an estimated 280,000 CY a year from other project channel work. The average shoal removal from Alafia River is about 130,000 CY a year. Assuming half that amount goes into disposal island 3D in the future, the total maintenance amount going into that island increases to 345,000 CY a year. If the 60,000 CY a year of shoaling from the existing Big Bend private project goes into the island, the total amount increases to an estimated 405,000 CY a year.

Disposal Island 2D. Construction grade material for higher dikes on disposal island 2D does exist on the island. A maximum dike elevation in the northern and southern portion would enable an estimated increase in capacity of about 10 million CY. Adding that increase to the existing capacity of 3.125 million CY in 1994 gives a total of about 13.1 million CY.

Shoal material for placement in 2D accumulates at an average rate of about 371,000 CY a year, excluding the Alafia River shoal material. Using that rate decreases the existing capacity to 157,000 CY a year by the end of 1998. Higher dikes increase the capacity by about 10,000,000 CY. The addition of about 65,000 CY in shoal material a year from the Alafia River maintenance in the year 2000 increases the shoaling rate to 436,000 CY a year. The life expectancy from the year 2000 is about 22 years for disposal island 2D.

OTHER DREDGED MATERIAL USES

Maximizing the potential for disposal of maintenance material from a Federal project is an important objective for continued channel usage. Several opportunities are available for use of material in a manner beneficial to the environment. A number of deep holes exists in Tampa Bay. Filling of those holes would improve the environment in them. Using material to expand islands for bird nesting is beneficial. Consideration of material for those uses benefits the environment and reduces the need for space within a disposal area. A beneficial uses plan with dredged material can be studied under a separate authority.

PROBLEM IDENTIFICATION

The major problem to shippers, using the existing Big Bend navigation features, is the lack of navigable channel depths and widths for safe and economic transport of their commodities. The existing channel does not allow optimum use of the current vessel fleet. The use of shallow to moderate draft vessels occurs at a higher unit cost for transport. Deeper depths for more draft and tonnage reduces the unit cost for transport and enables a greater vessel selection from larger vessels in the world fleet. The problem becomes even more prominent as the trend toward larger and deeper draft vessels continues in the world fleet.

NAVIGATION PROBLEMS

Discussions with the pilots indicate that navigation on the Big Bend channel is difficult in non-ideal conditions. Ideal conditions are characterized by slack tide in daylight hours with no wind. Under such conditions, the pilots take precautionary measures to handle vessel maneuverability. Navigation is more difficult when pilots must move a vessel under non-ideal conditions.

Wind. The predominant external force in Hillsborough Bay is the wind. The pilots will not transit the channel with an integrated tug/barge when winds are greater than 18 knots. Winds and cross currents acting on those vessels will cause it to crab or skew in the channel (see figure 6). A vessel that moves at a slight angle to the centerline of the channel uses more channel width. A vessel length of 750 feet requires an angle less than 10 degrees in the existing bottom width of 200 feet. An angle equal to or greater than that between the centerline of the channel and the ship in the center of the channel would be sufficient to put that vessel beyond the channel boundaries. Crabbing in the Big Bend Channel is a common occurrence due to the frequent high winds on Hillsborough and Tampa Bays.

Speed. Under the current situation at Big Bend, vessel movements are one-way. Normal currents vary from 1 to 2 knots. The passage is normally at a slow speed for approaching or leaving the terminals. Slower speeds cause a smaller force to act on the rudder and less response to rudder changes. The result is more difficulty in maneuvering to keep the vessel aligned in the channel. Safe passage with no cross currents to impact vessel movement requires the vessel to remain in the center of the channel to minimized bank suction that can cause maneuvering problems.

Bottom Width. Vessels that currently frequent the harbor have beams that range from 85 feet for barges to 106 feet for large bulk carriers. The existing channel bottom width is only 200 feet. The margin of safety is less than 50 feet on each side of larger ships with wide beams. The ratio of bottom width to vessel beam is less than 2 to 1 for the larger ships. The pilots prefer a 3 to 1 ratio for lesser risk when maneuvering difficulties occur in the channel. The extra width enables more response time to keep the vessel centered in the channel.

ECONOMIES OF SCALE

Inadequate channel depths and widths are resulting in ever-increasing inefficiencies in the use of the facilities located at Big Bend. Vessels currently utilizing Big Bend Channel are capable of handling more tonnage. Channel depths restrict drafts causing light-loaded conditions (vessels loaded to less than their maximum draft). Such movements are less efficient and result in higher shipping costs which can ultimately have an impact on competition within certain markets and consumer costs.

NEEDS AND OPPORTUNITIES

Opportunities arise from the channel widening which will minimize navigational difficulties associated with vessel transits into and out of Big Bend. Further opportunities exist in the form of advance maintenance since the channel is estimated to have a moderately high annual shoaling rate (80,000 CY per year) with more bottom area. Extra depth enables more shoal capacity to extend the time between maintenance cycles reducing the number performed over a 50 year project life and the overall costs.

Opportunities arise from increasing the efficiency of commodity movements through Big Bend Channel. Increases in efficiency would occur when vessels can carry more cargo per trip to reduce transportation costs and port visits associated with cargo movement. By increasing the amount of cargo per trip, the number of trips per year required to move a given amount of tonnage would decline resulting in less vessel traffic and lower unit costs for cargo transport.

PLANNING OBJECTIVES

The Federal objective in water and land resource planning is to make a contribution toward National Economic Development (NED) consistent with protecting the nation's environment. Specific planning objectives in conducting the study were to determine:

- The nature and extent of the navigation problems at Big Bend;
- The anticipated future navigation needs of the area;
- The resources that would be affected by the navigation improvements; and
- Executive Order 11988 which requires Federal agencies to recognize significant values of the 100-year flood plain and to consider the public benefits that would be realized from restoring and preserving those areas.

ALTERNATIVE PLAN EVALUATIONS

The alternatives included structural and non-structural plans. The structural alternatives involved various plans to consider channel depths, widths and disposal options during the formulation process. The non-structural plan is the most likely future condition without improvement or the "no action plan". A discussion of the various considered alternative plans is in subsequent paragraphs. The analysis is on the future conditions with those alternatives. The paragraphs provide the evaluation results that reduce the number of alternatives in order to identify the best plan for selection based planning objectives.

NO ACTION PLAN

Description. This plan provides nonstructural measures for future management and use of existing port facilities and navigation features in the study area. Maintenance of the existing navigation channels continues and current vessel criteria for entering and leaving the port would prevail with no change. Since Big Bend Channel is not a Federal project and no improvements would be constructed under this plan, maintenance of the existing navigation features continues to be non-Federal.

Discussion. The continuation of maintenance on the existing private project does not address the users need to handle future tonnage and vessel traffic in an efficient manner with minimum risk. The ability to increase efficiency, handle increasing tonnage demand, and reduce transportation costs is very limited for commodity movements on the existing Big Bend project. The plan does not meet the planning objectives set forth in this report but is the most likely base condition without improvement.

BOTTOM WIDENING PLAN

The U.S. Army Corps of Engineers' Waterways Experiment Station (WES) conducted a ship model simulation study on the Big Bend navigation features. That study was a design effort mainly to examine bottom alternatives such as width along the channel, wideners at turns, and turning basin area. The model simulates the forces, acting upon vessels as they transit the channels and turns at Big Bend. The model results are in appendix C as a Memorandum of Record with the subject "Final Findings on Big Bend Channel Navigation Study, Tampa Bay, Florida", dated 20 June 1994, from WES. Ship pilots, licensed for movement of vessels in the Big Bend area, assisted in simulating vessel movements on the model for evaluation and design selection.

Test Vessels. To be representative of the future fleet, the tests used two design vessels, an integrated tug and barge (ITB) unit and a self-propelled bulk carrier. The ITB had an overall length of 760 feet and a beam of 78 feet. The tug portion of the unit was twin screw. The barge had a bow thruster with no tug assistance. The ITB tests were with the barge at a light-loaded draft of 12 feet and a loaded draft of 32 feet. The bulk carrier had an overall length of 740 feet, beam of 105.75 feet, and a draft of 38 to 39 feet. The bulk carrier was single screw and used tug assistance for making turns in the turning basin and at the junction with the Tampa Harbor main ship channel.

Bottom clearances on the bulk carriers will likely remain the same as existing conditions resulting in some changes in bottom forces acting on the hull. Shallow water on each side of the channel causes the pilots to try and keep the vessels in the center of the channel to avoid bank suction. As vessels become wider, the bank clearances on either side of the vessel reduce if the channel width remains the same. That situation means the pilots have less channel area to correct for any unexpected change in vessel direction and a greater susceptibility to bank suction should the vessel deviate from the center area.

Channel Conditions. Model testing involved the existing channel bottom width, turn wideners, and turning basin except in one area. The figures in appendix C did not accurately depict the correct channel bottom limits on the Tampa Harbor main ship channel at the west end of the Big Bend entrance channel. The error is along the western edge of the main ship channel at the junction of A and C Cuts. The figures show a gap between the existing navigation channel markers and western edge of the channel. That is incorrect. The expanded area in figure 7 fills the gap and shows the correct location of the existing channel bottom that follows the markers around the turn.

Modeling Conditions. Model testing identified problems with maneuvering deeper loaded test vessels under existing channel bottom conditions with deeper depths. The ship simulation tracks in appendix C confirmed the areas that port pilot had difficulty staying within existing and corrected bottom width conditions. Model conditions also include design winds which were variable from the north averaging 15 knots.

Problem Analysis. Problems normally occur when water current and/or wind forces influence vessel movement. The impact of those forces is a serious problem in the entrance channel. That is the reach where the pilots reduce the speed of an incoming vessel in preparation for maneuvering and stopping in the turning basin to enter a berth. On leaving the port, the pilot is attempting to gain steerage and momentum in that reach.

When the pilot reduces speed, the vessel's propeller turns at slower revolutions per minute (RPM). The reduced RPMs decrease the water force on the surface of the rudder which reduces directional control of the vessel. That slowing process enables other forces (currents and winds) to become a greater influence on vessel movement. Attempts at maneuvering to overcome these forces are difficult at slower speeds.

Loaded vessels have more momentum and experience more difficulty in maneuvering than unloaded ones. This is due to the larger hull area under water for current forces to influence. Once underwater forces influence the vessel direction, it is very difficult to correct without increasing vessel speed to put more force on the rudder. The smaller the distance between the vessel hull and channel bottom results in greater resistance (bottom suction) to movement. The loaded vessels at Big Bend tend to have little bottom clearance which also causes slower responses in maneuvering.

Wind forces have more influence on the unloaded vessels which have more surface area above water. Those vessels normally do not have any problems with bottom suction in their light loaded conditions. With less momentum, the vessels are more easily maneuvered for adjusting to directional shifts. The pilots need to be alert to sudden wind forces and be able to correct before going aground. Again, pilots require the extra channel width to maintain a correct vessel angle to avoid being forced out of the channel by a strong sustained wind.

Test Results. Testing of both design vessels shows the pilots have difficulty in specific areas under certain conditions. Maneuvering problems occurred mainly in the entrance channel and turn on eastern end of that channel. Although the turns between the Big Bend entrance channel and C Cut in the main Tampa Harbor ship channel appeared to be a problem from the figures in appendix C, the adjustment to correct the existing bottom on the main ship channel eliminated most of that problem. The existing bottom width on the inner channel was no problem and is to remain the same.

Entrance Channel Width. The larger, loaded vessel movements under existing conditions have insufficient channel width for pilots to keep them in the channel. Model testing to correct that deficiency considered widening the existing bottom width. Considering the tracks of the vessels, a minimum increase of 50 feet was necessary in the model tests. Provision of that increase is possible in two ways. Plan A added 25 feet both north and south of the existing width. Plan B added 50 feet all to the north. Model results indicated both were safe design conditions but Plan B was more effective and is the WES recommended bottom plan shown in figure 7.

Entrance Channel End Turns. Testing results in appendix C showed vessel tracks in relation to the channel bottom boundaries at each end of the entrance channel. The tracks indicate the pilots are able to keep the vessels within the channel markers except in certain areas. Only those areas that appeared to have sufficient justification and reasonably minimized risk remained in the plan as discussed below.

- East End. The turning basin is on the east end of the entrance channel. The pilots stayed within the existing channel markers except in the turn between the entrance channel and inner channel. The most problem was with the outbound integrated tug and barge (ITB) unit as shown in figures 9-16 in appendix C. The expansion of the widener in figure 8 added the width to enable safer maneuverability as part of Plan B. Figures 17-22 in appendix C show the ship tracks under the widened condition on the east end.

- West End. The pilots turn the vessels between A and C Cuts on the main Tampa Harbor channel and the Big Bend entrance channel as shown in figures 23-37 in appendix C. The results of the tests are as follows:

  - A Cut. The pilots had no problems maneuvering the vessels within the existing bottom area between A Cut and the entrance channel. No changes are required for the turn.

  - C Cut. Modification of the existing widener is not necessary on the west side of the Tampa Harbor channel. The pilots made the turns successfully and within existing navigation markers between C Cut and the entrance channel except in one circumstance. That occurrence was in turning an inbound, loaded, bulk carrier into the Big Bend channel from C Cut. The pilots slowed to around one knot and used tugs to stay within the channel. As the likelihood of that movement is rare based on past and prospective usage, benefits from any savings would be small. Shallow water in that area is likely to require an extensive amount of dredging and cost to widen. The small amount of usage does not provide sufficient justification for improvement. Widening in that area is not recommended.

Turning Basin. An expansion of the turning basin to the east beyond the existing markers could be a problem. Port Redwing does not have a bulkhead and water depths adjacent to the shoreline are shallow. Dredging close to the shoreline in that area could result in excessive dredging as side slopes cause loss of land. Depths are already shallow around the northeast marker in the basin. The recommendation is not to expand the basin any farther eastward than the existing marker to the southeast at the entrance to the phosphate terminal as shown in figure 8.

PLAN B - DEEPENING ALTERNATIVES

Figures 7 and 8 show Plan B (existing and expanded bottom area configurations). The areas under consideration for deeper depths are the entrance channel, turning basin, inner channel, east channel, and berthing areas. Depth selection is an economic determination based on the justification for deepening those bottom areas.

An economic analysis compares average annual equivalent (AAEQ) benefits with AAEQ costs for construction and maintenance of Federal and associated projects. That comparison enables a determination as to which depth provides the maximum excess benefits over costs. That depth identifies the National Economic Development Plan. A detailed evaluation of the benefits is in appendix B. Table 3 provides a summary of benefits from that appendix for the various depths under consideration.

TABLE 3

BENEFIT ESTIMATES BY PROJECT DEPTH

Items	Average Annual Benefits ($1,000) by project Depth in feet 1/						
	37	39	40	41	42	43	44
Barge Carriers							
Coal - Domestic Source	32.0	32.0	32.0	32.0	32.0	32.0	32.0
- Foreign Source	20.1	20.1	20.1	20.1	20.1	20.1	20.1
Phosphate Rock	651.9	703.5	703.5	703.5	703.5	703.5	703.5
Granulated Triple Super Phosphate	19.1	19.1	19.1	19.1	19.1	19.1	19.1
Self-Propelled, Bulk Carriers							
Coal	490.1	1,386.8	1,818.4	2,126.4	2,201.6	2,272.0	2,338.0
Granulated Triple Super Phosphate	355.5	413.1	428.4	443.6	449.4	449.4	449.4
Tankers Phosphoric Acid	277.8	373.1	384.1	384.1	384.1	384.1	384.1
Total Benefits	1,846.5	2,947.7	3,405.7	3,728.8	3,809.9	3,880.3	3,946.5

1/ Interest rate and discount rate are at 7.625 percent. Project life for the benefit analysis is 50 years. Vessel operating costs are at 1996 price levels.

Benefits come from transportation savings associated with the future vessel fleet using deeper drafts on considered channel depths for access to Big Bend terminals. The benefit evaluation for transportation savings involved the movement of coal to the Big Bend power plant and the movement of phosphate rock and chemicals from terminal facilities near the turning basin.

The coal and phosphate movements all use the entrance channel and turning basin. The inner channel connects the electric power plant coal terminal to the turning basin. The only movement on that channel is coal. The east channel extends east from the turning basin between Port Redwing and the phosphate terminal berths. Deepening of the east and inner channels is a separable element which considers only the respective bulk movements using them. The analysis of vessel loadings associated with prospective fleets at different channel depths provides the basis for the incremental analysis.

DISPOSAL ALTERNATIVE EVALUATION

Appendix F is a dredged material management plan for the Big Bend proposed project. The objective of that plan is to determine the most cost efficient method of disposal for initial construction and future maintenance over the first 20 years or more on the project. The least cost disposal alternative becomes a part of the National Economic Development (NED) plan. That plan must be consistent with environmental guidelines and regulations for implementation.

Disposal area evaluations in that appendix considered:

- Disposal island 3D,
- Upland areas on the mainland,
- Offshore site for Tampa Harbor,
- Beach placement, and
- Beneficial use areas for dredged material from construction and maintenance of Plan 1.

The subsequent discussion provides a brief summary of the findings in that appendix.

Offshore Dredged Material Disposal Site (ODMDS). The Environmental Protection Agency (EPA) selection process, ongoing for several years, is now complete. EPA has designated a site about 7.6 miles southwest of the entrance marker on the Tampa Harbor Federal Channel. Figure F-1 in appendix F shows the location of the ODMDS.

The Federal emphasis in dredging is to minimize cost consistent with environmental considerations. Estimated excavation and transport of the material for the most efficient cost uses a clamshell for dredging and barges for hauling to the ODMDS. Compared to upland disposal possibilities in the Big Bend area, the ODMDS cost is nearly twice that of upland disposal. That site is too far from the proposed project for economical use.

Beach Nourishment. The material dredged during construction and maintenance is expected to have a high percentage of fines. Such a percentage makes the material unsuitable for placement directly on a beach. Separation of fines is not a cost efficient process to enable suitable material for beach placement.

Disposal on Islands South of Big Bend Channel. Past dredging operations created two islands with two shallow water areas between them. Those areas are parallel with and south of the Big Bend Channel. The two areas are about 3 feet below mean low water (mlw). Environmental agencies strongly oppose any further disposal of material in that area due to the nearby presence of submerged aquatic vegetation and shallow water habitat. Based on the potential adverse environmental impact, that disposal option is no longer a consideration.

Upland Disposal. An analysis of upland alternatives involved over 30 old and new sites in the Big Bend and Alafia River area. About 10 of those sites had significant adverse environmental impacts associated with development resulting in their elimination. Historically, several existing upland areas have been in use within the study area. The two existing sites, one at Alafia River and the other at Big Bend, are for private use with limited capacity. Continued use of the areas is part of the analysis on available capacity for future disposal of material. The remaining sites underwent a cost analysis to determine the least cost alternative. The estimated cost on each of those sites was more than the cost to use disposal island 3D. No further consideration was given to use of those sites.

Disposal Island 3D. The Tampa Port Authority (TPA), as the sponsor of the proposed project, wants to use the island for disposal. Suitable material on the island is not sufficient to increase the dike height 20 feet. Big Bend new work dredging is a source of suitable material for that dike construction on 3D. Placement of initial construction material into that disposal island is the most cost efficient means of getting suitable material for raising the existing dikes.

Beneficial Use Sites. The beneficial use of dredged material involves the placement of material in a manner that could enhance the environmental quality of the area. Beneficial uses for dredged material were considered during the formulation of a disposal plan.

The Fish and Wildlife Service suggested two beneficial uses of the dredged material to enhance the environment. A discussion of the potential plans for beneficial use of dredged material is in appendix F. One is to use the material on Sunken Island shown on figure 9. About 545,000 cubic yards of suitable construction material is necessary to implement that plan. The second is to fill holes in the Whiskey Stump Key area shown on figure 9. An estimate of the material needed is about 950,000 cubic yards.

The fine material is likely to be in non-uniform layers and pockets throughout the dredging. Dredging mixes the good course material with the fines. The mixture is a problem because it will probably contain an estimated 40-50 percent fines. That high a percentage is a water quality problem for direct placement into a proposed beneficial use area. The mixture can cause high levels of turbidity that is undesirable in the beneficial use areas without adequate containment for control and separation.

The estimate of material, suitable for enlargement of Sunken Island, does not appear to be of sufficient quantity at this time to repair years of erosion. Filling the borrow holes at Whiskey Stump Key requires an estimated 950,000 cubic yards of material. The current estimates of suitable material appears less than sufficient to fill the holes. A possible solution is to use the fines in disposal island 3D as a substitute for suitable material. The process would involve placing the fines in the holes first then using the suitable material to form a cap over the fines. The amount of suitable material would need to be enough for a minimum thickness of 1-foot. The amount of material for that thickness would require about 80,000 cubic yards. A deeper cap of 3 to 6 feet may be possible if the current estimates of suitable construction material are accurate.

The estimated construction cost for filling the holes involves the movement of about 600,000 CY of fines and 350,000 CY of suitable material from disposal island 3D to Whiskey Stump Key. The added cost for that work, as part of the Big Bend dredging project, is estimated at $6.7 million. To do the work as a separate construction project after the Big Bend dredging has an estimated cost of about $5.2 million. Development of more detailed plans and costs is difficult until after disposal and separation occurs on disposal island 3D. A more accurate estimate will be possible at that time based on actual measurements.

The preliminary findings indicate the high percentage of fines in the dredged material is not desirable for a beneficial use plan. Such plans, using direct placement of that material into sites, have a high cost. Placing the material directly in disposal island 3D is more cost efficient. A beneficial use plan may be a consideration in the future using available material in disposal island 3D under another authority to benefit the environment.

Conclusion. The most cost efficient plan for disposal is to place the material into disposal island 3D. The estimated high amount of fine material to be dredged is a costly problem for placement in any other area that has no room for containment. The Tampa Harbor project needs the disposal area capacity for maintenance dredging. The material from the Big Bend dredging is necessary for dike construction to obtain a maximum elevation of 40 feet above mean low water. Based on the estimate of fines and an analysis of excavation quantities at different channel depths, not all deepening and widening plans provide sufficient suitable material for dike construction to the maximum elevation.

The Tampa Port Authority desires the first priority for use of the suitable material to be for dike construction. If dredging produces less fines than now estimated from the excavation, more suitable material would be available for use. The amount of material from the deepening and widening is also a factor in the determination of suitable material. Considering those variables, the first step is to assess the availability of suitable material for dike construction to an elevation of 40 feet above mean low water.

To determine the amount of suitable material to be derived from the dredging, a separation must occur first in a suitable area. A natural process occurs with hydraulic dredging and placement that causes most of the fine material to flow away from the discharge pipe and settle in the most distant area from that point. The suitable material settles with some of the fines nearest the discharge point. Once that natural process is complete, a determination is possible as to the quantity of suitable material for all desired uses. If sufficient suitable material is available, consideration may be possible for both dike construction and future beneficial uses.

DISPOSAL ISLAND 3D DIKING

The available capacity in disposal island 3D with the existing dikes is about 1,362,000 cubic yards (CY)in 1994. An increase in the dike elevation is possible with existing material in the southern end of that island. The amount of suitable construction material is an estimated 1,700,000 CY. That amount is sufficient for construction of a dike to an elevation of about 32 feet above mean low water. The amount of material for excavation at various channel depths and the corresponding dike requirement for that material on disposal island 3D are in table 4.

MAINTENANCE COST EVALUATION

Maintenance on the existing channel, turning basin, and berthing areas involves the removal of shoal material and work on navigation aids to keep them operating. The U.S. Coast Guard estimates the maintenance of navigation aids on the bottom configuration from model testing at $3,000 a year. Estimates of shoaling come from historical records of such work performed at local expense.

TABLE 4

ESTIMATED EXCAVATION AND DIKE QUANTITIES

DEPTH (FEET) 1/	1,000 CUBIC YARDS		DIKE		
	2/	3/	4/	5/	6/
37	1,746	1,100	23	137	
38	1,949	1,230	24	220	2,360
39	2,273	1,430	24	220	2,360
40	2,561	1,610	25	322	2,800
41	2,857	1,800	26	443	3,260
42	3,161	1,990	26	443	3,260
43	3,477	2,190	27	582	3,700
44	3,809	2.40	28	740	4,150
45	4,164	2,620	29	916	4,580

1/ Required depth of dredging or contract depth.
2/ Gross dredging excavation quantity with the required depth plus an allowable of 1 foot.
3/ Silt estimated at 45 percent of dredged material. About 37 percent estimated to settle as fines. Amount of suitable material for dike construction estimated at about 63 percent of the dredged amount.
4/ Dike elevation in feet.
5/ Quantity of material needed to increase dike height over 20 feet in 1,000 cubic yards.
6/ Capacity in 1,000 cubic yards added with only the increase in dike height above 20 feet.

The average annual shoaling from past records is an estimated 60,000 cubic yards on the existing navigation conditions. Based on that information, an expansion in the bottom area with widening increases the potential shoaling area. That quantity spread over the existing bottom area provides a depth of about 0.44 feet of uniform shoaling.

The considered plans will increase the bottom from 3,645,000 to 4,943,000 square feet. That increase in bottom area raises the annual shoaling to about 80,000 cubic yards. That higher value became the basis for future shoaling with improvement. The different depth considerations are not likely to have a significant influence on the amount of shoaling.

The cost analysis is for the removal of about 240,000 cubic yards of accumulated sediment every 3 years. The estimated cost for that removal includes mobilization and demobilization of equipment along with turbidity monitoring. Past records on maintenance of Tampa Harbor indicate the costs of shoal removal are expensive and routinely done in one area at a time. The reasons are budget and environmental windows limiting dredging and disposal operations. Combining maintenance in two areas requires a significant budget and requires a larger environmental window than available for one dredge to complete the work.

Maintenance dredging every 3 years is likely to involve mobilization and demobilization of equipment for a majority of the work during a 50 year period. The combination of maintenance work at Big Bend is at best a possibility once every third cycle. The estimated cost of maintenance every 3 years with equipment mobilization, dredging 240,000 cubic yard, turbidity monitoring, and manatee monitoring is about $2,048,000. The removal of equipment mobilization reduces the cost down to $1,033,000 for removal of 240,000 cubic yards. The price level is April 1996.

The estimated present worth value of each maintenance event every 3 years over a project life of 50 years is $7,016,700 with no equipment mobilization every third cycle. Interest and amortization of that total present worth value at an interest rate of 7.625 percent over the project life produces an average annual equivalent (AAEQ) cost of $549,000 for shoal removal.

ENVIRONMENTAL EVALUATION

An environmental assessment of the dredging area indicates no significant impact on the quality of the human environment from the considered widening and deepening plans. The terminal owners in the area provided the existing manmade navigation features for deep draft vessel movements. They maintain those features for current vessel traffic.

Manatees. They are a threatened and endangered species that do appear in the area during certain seasons. A warm water outfall from the electrical generating plant attracts the manatees in winter months. They tend to congregate in that area which has barriers to separate it from the existing navigation features. Manatees have no easy or direct access from the warm water outfall area to the navigation channels. They normally do not frequent the navigation features as no seagrasses exist in that area for food. No problem with manatees has occurred in previous dredging events. Any dredging contract will include:

- Standard Federal and State manatee protection conditions;
- Provision for a trained biologist, approved by the Fish and Wildlife Service and/or Florida Department of Environmental Protection, to be aboard the dredge;
- No dredging at night during the winter manatee window with the use of a clamshell dredge to do the excavation; and
- Placement of propeller guards on the auxiliary vessels moving supplies and personnel between the dredge and shore.

Birds. There will be no impact to migratory birds if construction takes place between 1 September and 31 January.

Cultural Concerns. The dredging poses no threat to known sites of cultural or historical significance.

TERMINAL FACILITY EVALUATION

Deepening of the channels and turning basin at Big Bend will enable the use of deeper loaded vessels. To handle those vessels, changes are necessary in the berths and terminal facilities. Those changes are non-Federal costs and are identified as associated alternatives with the deepening project. Items that go under that classification include berth deepening, bulkhead modifications, and landside equipment and terminal changes as a result of the improvements.

Phosphate Terminal. To handle deeper loaded vessels at that terminal, the berthing area needs deepening with all channel depth considerations. The bulkhead, adjacent to the berth, is at a design depth that will enable berth deepening to match the channel depths under consideration without modification. Landside equipment and terminals are adequate to handle the prospective ships and cargo with deepening alternatives.

Coal Terminal. The coal terminal will require more extensive modifications. The berthing area needs deepening with all channel depth alternatives. The bulkhead adjacent to the berthing area requires modification to enable deeper berth depths of 36 feet or more. To handle the self-propelled coal carriers in the benefit analysis, the terminal operator indicates the ladder loader needs to be replaced with a new bucket loader. The existing ladder loader was about 25 years old in 1996. The life expectancy is about 30 years. Replacement of the ladder loader is likely to occur under existing conditions in 2001.

FIRST COST ANALYSIS

To complete an economic evaluation for selection of a project depth, an analysis of first costs is necessary for channel deepening and material disposal along with the associated non-Federal costs necessary to obtain the benefits. Associated costs for the considered depths at Big Bend are necessary changes to existing berths and terminal facilities to accrue benefits from deeper loading of vessels. The depths under consideration apply to the bottom configuration in figure 7 and include berthing areas for the deeper draft ships. Quantity estimates on the amounts for excavation are from a 1994 hydrographic survey after maintenance work on the existing navigation features.

Deepening Plan. Each plan involves dredging to a certain depth and placing that material into disposal island 3D. Appendix A provides the engineering aspects considered for dredging and placing material into that island. Appendix F has the engineering aspects of raising the dikes in disposal island 3D for placement of the dredged material. The estimated cost includes the following on all depth considerations:

- Mobilization and demobilization of equipment,
- Dredging and disposal of material from navigation features and berthing areas,
- Dike construction,
- Navigation aids,
- Turbidity and manatee monitoring,
- Preconstruction engineering and design work, and
- Construction management.

Table 5 is an estimate of total first costs at April 1996 price levels for constructing different depths on the channels, turning basin, and berthing areas. The costs include one foot allowable overdepth for dredging inaccuracies. The U.S. Coast Guard provided estimates for placing and maintaining navigation aids. The costs of constructing navigation aids is the same for all depths. That cost includes new inbound and outbound ranges as well as new channel markers.

Associated Costs. The berth and terminal changes necessary for the realization of the benefits are the associated cost items for the various depth considerations. Those costs include dredging of the berthing areas, bulkhead work to enable deeper berth depths, and a replacement crane to unload coal from self-propelled ships. Information for the analysis of the bulkhead and crane replacement came from sources in the study area.

Berthing area and considered project dredging costs are together in that table under the heading of deepening plans. The estimated costs for modifying the coal terminal bulkhead is under the associated cost column heading in table 5 for each depth. The replacement crane for unloading coal from self-propelled bulk carriers was a consideration but a cost analysis indicated the bucket crane was the least cost alternative. That analysis took into account the initial and annual cost on both cranes as well as the remaining life and life expectancy of each one at a market interest rate of 9.75 percent. Unloading rates are not significantly different.

The existing ladder crane is about 25 years old with an estimated life of about 30 years. Replacement of that crane is likely to occur about the year 2001 without the considered navigation improvements. A similar crane has an estimated replacement cost of about $10-12 million. The approximate salvage value on the existing crane is about $595,000. The net cost is about $10.4 million ($11 million minus $595,000 salvage value). The present worth value of that amount from the years 2001 and 2031 to the year 1999 is about $9.16 million at an interest rate of 9.75 percent.

A replacement bucket crane has an estimated value of $5.2 million and a salvage value of $220,000. Using the salvage value of the ladder crane in 1999, the net replacement cost is $4.6 million in that year. The life of the bucket crane is about 27 years. The estimated replacement cost in 2026 is about $4.98 million. The total present worth value in 1999 for the initial and replacement bucket crane in the future is $5.01 million at 9.75 percent.

Maintenance of the two cranes involves routine and major overhaul cost over the projected life. The amounts for each are as follows:

Item	Amounts by Crane Ladder	Bucket
Routine annual maintenance ------	$ 80,500	$300,000
Major overhaul:		
Frequency (years)-	7	8
Cost per event ---	$952,000	$450,000
Average annual equivalent cost --	$172,000	$313,000

The average annual equivalent value of the first cost for the cranes needs to be added to the maintenance cost. Interest and amortization of the total present worth value for a bucket crane ($5.01 million) and ladder crane ($9.16 million) over 50 years at an interest rate of 9.75 percent is an average annual equivalent (AAEQ) value of $493,000 and $902,000, respectively. The combined AAEQ values for maintenance and first cost of the ladder ($1,074,000) and bucket ($806,000) cranes indicate the ladder crane has a higher AAEQ cost than the bucket by $268,000. A new bucket crane adds no additional cost over the without project condition with a ladder loader.

INTEREST DURING CONSTRUCTION

Interest During Construction (IDC) is on the total first cost of channel deepening with the associated costs. Calculation of IDC has several different conventions. The convention, used to calculate the IDC, involved payment at the beginning of every month with the interest (7.625 percent annually) applied at the middle of the month. Construction of the considered channel deepening plans is to be in one contract. Construction of associated items is concurrent with the channel. Interest starts to accrue during Preconstruction Engineering and Design (PED) and stops at the beginning of the base period for project life.

Period zero of the economic life is January 1999 since construction is scheduled for completion in March 1999 with the first full year of the project being the year 2000. PED will start near the end of Fiscal Year 1997 (September 1997). Appendix E provides an example of the detailed breakdown of those costs with respect to time. The distribution of those costs provide the basis for determining the IDC costs for implementation of each depth plan as summarized in table 5.

AVERAGE ANNUAL EQUIVALENT (AAEQ) COST

The total AAEQ cost on each depth plan consists of several components. The first component is the interest and amortization value of the total economic first cost on each deepening plan in table 5. The estimated maintenance of the channel and navigation aids is the second component. The third component being the added maintenance on the associated cost items. The total AAEQ costs is in table 6 for each depth under consideration.

TABLE 5

ESTIMATED TOTAL FIRST COSTS OF VARIOUS DEPTH PLANS

Depths in feet	Amounts in $1,000			
	Deepening Plan	Associated Cost 1/	IDC 2/	Total Economic Costs
37	5,217	1,333	17	6,567
38	5,733	1,467	19	7,219
39	6,270	1,600	20	7,890
40	7,217	1,733	24	8,974
41	7,789	1,867	42	9,698
42	8,229	2,000	44	10,273
43	9,215	2,133	50	11,398
44	10,264	2,266	79	12,609
45	11,382	2,400	88	13,870

1/ Bulkhead cost range from $1.2 million at a depth of 36 feet to $2.4 million at a depth of 45 feet.
2/ Interest during construction (IDC)

TABLE 6

SUMMARY COMPARISON OF BENEFITS AND COSTS BY DEPTH

ITEM	Average Annual Equivalent Amounts ($1,000) by Depth					
	37	39	40	41	42	43
Benefits	1846	2948	3406	3729	3810	3880
Costs - Economic 1/	514	617	702	759	804	892
Maintenance 2/	552	552	552	552	552	552
Total Costs	1066	1169	1254	1311	1356	1444
Net Benefits	780	1779	2152	2418	2454	2436
Benefit-to-cost ratio	1.7 to 1	2.5 to 1	2.7 to 1	2.8 to 1	2.8 to 1	2.7 to 1

1/ This is the channels (entrance, east and inner), turning basin, berths, and bulkhead modification total economic first costs amortized over a expected life of 50 years at an interest rate of 7.625 percent.
2/ Maintenance of the channel is $549,000 and navigation aids $3,000.

Total Economic First Cost. The average annual equivalent cost is over a specific period of time. That period on the deepening plans is a project life of 50 years with proper maintenance. The associated cost have an estimated life over that same period except for the replacement crane. The crane has an expected life of 27 years. The AAEQ values come from determining the interest and amortization values of the total economic first cost over the expected life of that placement with proper maintenance. The interest rate for determining the AAEQ values is 7.625 percent. The estimated values are in table 6.

Channel and Navigation Aids. The estimated cost for maintenance of the channel, turning basin, and navigation aids remains the same for each depth plan. The AAEQ cost for channel maintenance at each depth is an estimated $549,000. Maintenance of the navigation aids is an estimated $3,000 a year.

Associated Cost Items. The analysis of maintenance considered the berthing areas and bulkhead. The deeper berthing areas have no significantly increased area for accumulation of material. No additional maintenance is estimated for the berths. The modified bulkhead should not cause a significantly higher maintenance nor should there be any additional maintenance on the existing bulkheads.

DEPTH ANALYSIS

The analysis in table 6 is for the turning basin and connecting entrance, inner, and east channels. Amounts in that table are average annual equivalent (AAEQ) values for both costs and benefits over an economic project life of 50 years. The interest rate is 7.625 percent. The total present worth amount then converts to an AAEQ value using interest and amortization of that amount over the expected economic life of the deepening plan or associated item. The depth that maximizes excess AAEQ values of benefits over costs becomes the National Economic Development (NED) plan. The NED plan from table 6 is the selected depth.

Economic analysis of deeper draft ship movements provides a basis for comparing estimated benefits and costs. The estimated benefits are from transportation savings at each increment of depth in table 3. The costs are in table 6 and include annualized values for the economic first cost and maintenance. The comparison between annualized costs and benefits in table 6 is for the full length of the channels (entrance, east, and inner) and turning basin. A second analysis in table 7 and 8 is for the inner and east channels as separate increments.

All Channels and Turning Basin Combined. Table 6 provides the comparison of AAEQ values of costs and benefits at several depths for all channels and turning basin under consideration. Where benefits optimize over cost is the NED plan or the one that reasonably maximizes the net AAEQ value for benefits in excess of costs. As shown in that table, the net AAEQ benefits maximize at a considered project depth of 42 feet. Both coal and phosphate movements receive benefits with a depth of 42 feet.

Inner Channel Increment. The inner channel extends south from the turning basin shown in figures 7 and 8. Table 7 provides a summary of the average annual equivalent (AAEQ) values for benefits and costs for each depth increment along the inner channel segment. A sample of the initial cost for at a depth of 41 feet in that table and the AAEQ value is as follows:

Deepening the channel segment --------	$ 397,000
Berthing area dredging ---------------	202,000
Dikes and weirs ----------------------	169,000
Environmental monitoring -------------	3,000
Subtotal -----------------------------	$ 771,000
Design and costs ---------------------	62,000
Construction management --------------	77,000
Subtotal -----------------------------	$ 910,000
Terminal bulkhead modifications ------	1,866,000
Total first costs --------------------	$2,776,000
Average annual equivalent (AAEQ) value	$ 217,000

Table 7 has estimated AAEQ values of about $71,000 for dredge and disposal work as well as about $78,000 for maintenance of a project depth of 41 feet.

TABLE 7

SUMMARY COMPARISON OF BENEFITS AND COSTS INNER CHANNEL

INNER CHANNEL INCREMENTAL ANALYSIS						
ITEMS	Average annual Equivalent Amounts ($1,000) by Depth in Feet					
	37	39	40	41	42	43
Benefits	542	1438	1870	2179	2254	2324
Costs - Dredging 1/	116	125	137	149	155	169
- Bulkhead	104	125	136	146	156	167
Total costs	220	250	273	295	311	336
Net Benefits	322	1188	1597	1884	1943	1988
Benefit-to-cost ratio	1.7 to 1	5.8 to 1	6.8 to 1	7.4 to 1	7.2 to 1	6.9 to 1

1/ Dredging includes maintenance estimated to be an AAEQ value of about $78,000 at each depth.

The benefits from coal movements apply only to the inner channel. The coal benefits on that channel range from about 39 to 60 percent of total benefits at considered project depths of 37 to 43 feet, respectively. The incremental analysis in table 7 shows maximum net benefits over cost is at a depth of 43 feet. The incremental change in benefits and net benefits between 40 and 41 feet is significant (5 percent or greater) but between 41 and 42 as well as 42 to 43 they are not. Depths deeper than 41 feet do not show a significant incremental change in benefits or net benefits between depths. The selected depth for the inner channel is 41 feet which is the selected depth plan from table 6 for all the channels and turning basin.

East Channel Increment. The channel is east of the turning basin as shown in figures 7 and 8. Table 8 provides a summary of the average annual equivalent (AAEQ) values for benefits and costs at considered depth increments along that channel segment.

The incremental analysis in table 8 indicates the benefits are large in comparison with costs. The benefit-to-cost ratios for that channel are high. Comparison of costs with benefits is feasible. The table indicates the maximization of benefits over costs occurs at a depth of 42 feet. The incremental change in benefits and net benefits between depths is significant if it is 5 percent or greater. Depths deeper than 39 feet do not show a significant incremental change in benefits or net benefits between depths. The costs for the various depth increments up to 43 feet are small. The benefits are from the phosphate rock and chemicals that move only on that channel.

TABLE 8

SUMMARY COMPARISON OF BENEFITS AND COSTS EAST CHANNEL

EAST CHANNEL INCREMENTAL ANALYSIS							
ITEMS	Average Annual Equivalent Amounts ($1,000) by Depth in Feet						
	37	38	39	40	41	42	43
Benefits	1304	1439	1509	1535	1550	1556	1556
Costs 1/	132	132	136	141	151	156	169
Net Benefits	1172	1307	1373	1394	1399	1400	1387
Benefit-to-cost ratio	9.9 to 1	10.9 to 1	11.1 to 1	10.9 to 1	10.3 to 1	10.0 to 1	9.2 to 1

1/ Dredging includes maintenance estimated to be an AAEQ value of about $67,000 at each depth.

The costs in table 8 include the initial costs for dredging and disposal of material as well as maintenance. The initial cost at a project depth of 41 feet is as follows to illustrate the initial costs which provides the basis for the AAEQ values in that table:

Deepening the channel segment --------	$ 481,000
Berthing area dredging ---------------	240,000
Dikes and weirs ----------------------	186,000
Environmental monitoring -------------	4,000
Subtotal -------------------------	$ 911,000
Design and costs ---------------------	73,000
Construction management --------------	91,000
Total first costs -----------------	$1,075,000

Table 8 includes the AAEQ value of $84,000 for the estimated initial costs at a project depth of 41 feet as well as about $67,000 for maintenance of that project depth.

Disproportionate Incremental Investment. EP 1165-2-1 (15 Feb 96) 12-6c, states the following in regard to the principle of progressive development: "The Federal interest is satisfied and the regular cost sharing requirements apply where the improvement serves/benefits two or more properties having different owners or one publicly-owned property at the outset or if new properties/owners would be served immediately after project completion. A principle of progressive development also applies. Progressive development includes nominal incremental extension "end of the line" situations where part of the improvement is a last project increment serving the last non-public property or property owner. The last property/property owner served may be "at the end" in terms of length, depth, or width, necessitating some project investment in that service alone. This is treated as a multiple-owner situation unless *disproportionate incremental investment* is required."

Disproportionate can be in the form of benefits and/or costs. The channel was incrementally justified so the additional costs for construction are less than the benefits from construction. The benefit to cost ratio is 7.4 for the inner channel and 10.3 for the east channel. The entire project involves construction of approximately 17,200 feet of channel. The increments in question amount to approximately 5,600 feet which is 33 percent of the channel length for 17.5 percent of the cost. The channels pass both tests.

Accuracy of costs and benefit calculations should also be considered. The project cost estimate has a 20 percent contingency factor. The benefit calculations are based upon projections over a fifty year life. The 17.5 percent portion of this project is well within the tolerances of accuracy for both cost and benefit calculations. Further, when assessed separably, the percentage values for each segment (8.0 and 9.5) are also within the realm or margin for analytical error regarding economic analyses (estimation of base vessel operating costs by IWR, aggregation of inputs for terminal and vessel operating parameters, and forecasts of future maritime activities pertinent to project studies). In addition, when assessed in combination or as separable elements, estimated benefits as assessed in the report exceed marginal costs by a considerable margin, which is consistent with overall findings for project studies and economic justification. Finally, the percentage shares when assessed separably are reasonable equivalent given consideration of total costs, and the placement of both features represents equitable treatment to both users of the waterway.

Risk and Uncertainty Associated With Critical Assumptions

Current requirements mandate examination of potential risk and uncertainty (R&U) associated with estimates and assumptions which are critical to project justification and\or plan formulation. R&U was assessed through basic sensitivity analyses and discussion of certain variables or influences viewed as critical to project justification. Project justification is based upon a limited number of port users, notably the Tampa Electric Company (TECO) and IMC\Agrico, Incorporated.

Respective to TECO and movements of coal, review of project benefits reveals that the majority of benefits are based upon expected transportation efficiencies for waterborne transport of domestic and foreign coal for Big Bend Station. For depths greater than 40 feet mlw, efficiencies for coal transport range from 55 to 60 percent of total benefits. Related efficiencies are largely attributable to self-propelled bulk carriers for handling coal from Indonesia via the Panama Canal or from nations such as Colombia and Venezuela on the northern coast of South America.

Exclusive use of domestic coal would preclude the ability to reduce emissions without significant plant retrofit. Exclusive use of low-sulphur coal would restrict fuel to low or possibly insufficient Btu rating for economical plant operation. The cost per Btu of fuel from low-sulphur coal has been equal or less than the average cost of domestic coal which is higher in sulphur and ash content. The coal sources are a consideration of operating costs relative to power generation subject to constraints imposed for air quality. Air quality is improved through the use of scrubber systems, efficiency measures in the boilers or combustion units, the use of cleaner-burning fuels (low sulphur coal), or some combination thereof. Air quality regulations place limits on sulphur content, ash content, energy generated unit of fuel, total operating cost per unit of energy, and technology of the generating facility. Relative sulphur content tends to be the most directly related to efforts to improve air quality when using coal. Relative sulphur content reductions result in lessening of sulphur dioxide (SO_2) emissions per unit of power. The SO_2 emissions are a primary component of present and evolving air quality regulations at State and Federal levels. The alternative to significant use of low-sulphur coal includes coal blends with higher sulphur content in combination with scrubber.

The Tampa Electric Company (TECO) is in the process of deciding on whether to employ additional scrubbers at Big Bend Station. Available information indicates the construction of such measures would cost $70 to $80 million dollars or more for initial construction and approximately $1.5 million or more for maintenance and operation. Basic analysis of available information indicates channel improvements and importation of foreign-source coal on self-propelled carriers should be economically viable for the foreseeable future. The production of coal from foreign sources is expected to remain stable in availability and price as new sources such as China, South America, Australia, and Indonesia further develop the infrastructure needed to efficiently extract and transport known reserves. Proposed improvements should lower the costs of imported coal by approximately $3.60 to $4.30 per short ton which would make most imported coal from South America or Indonesia less costly than virtually all domestic sources. Even if implemented in tandem with scrubbing, available cost relationships for powerplant maintenance and operations indicate that fuel blending would still result in sufficient economic benefits for scrubber maintenance, plant operations, and fuel costs to more than offset associated costs of proposed waterway improvements.

TECO routinely employs multiple sources for fuel wherever practical to minimize dependency on one or a select few suppliers to encourage competitive pricing and limit susceptibility to price fluctuations in both domestic and foreign regional markets. TECO is expected to continue this practice.

TECO has to modify its current operations in order to achieve the benefits needed to justify the selected/NED plan. A lesser plan (37 feet) is economically justified and within current Administration policies. The Tampa Port Authority will not undertake the improvement project without the administrative and financial support from TECO and IMC/Agrico. Even if TECO has no plans to modify its current operations, a lesser channel of 37 feet could be constructed.

An element of uncertainty concerning benefits for IMC\Agrico operations is the exact time period for depletion or viability of phosphate reserves for exportation of wetrock and phosphate-related products. The period of reserve viability will be governed by market prices for phosphate products versus costs of extraction, quantity, and quality of product. Indications are that operations in the area should remain economically viable for at least 20 to 25 years beyond the project base year. Given the interest\discount rates mandated for life-cycle costing, any minor variability in the planning horizon would be of little concern.

Overall risks are small that a project would be constructed that will not realize enough benefits to cover the costs. The chances are higher that a lesser than authorized/NED plan could be constructed because the current users could realize benefits without making changes to their current operations.

Depth Summary. The entrance channel and turning basin provide access to the inner and east channels that have a separate incremental analysis. The incremental analysis of the inner and east channels is in tables 7 and 8. The overall analysis in table 6 is for all the channels (entrance, east, and inner) and the turning basin. All these tables show a maximization of benefits over costs occurs at a depth over 41 feet. However, tables 6 and 7 show the increase in benefits and net benefits between each increment of depth over 41 feet is not significant (less than 5 percent). The east channel analysis in table 8 indicates the increments of benefit between depths deeper than 39 feet is not significant. An overall depth of 41 feet is selected for all channels and turning basin in consideration of the following:

- Maximization of benefits over costs occur at depths deeper than 41 feet;

- East channel cost estimates are less than 5 percent of the overall project; and

- Maximum benefits with multiple usage is possible at a depth of 41 feet on the entrance channel and turning basin.

ADVANCED MAINTENANCE

The estimated AAEQ maintenance cost for each of the depths is a major portion of the total AAEQ costs in table 6. As mentioned in the Needs and Opportunities Section of this report, advance maintenance is a way to reduce that high annual costs. Two factors help lower the AAEQ cost:

- One is a deeper shoal depth to enable more cost efficient (lower unit cost) dredging and

- Two is an extension of time between maintenance cycles with added depth for more storage capacity to reduce the number of cycles in the 50 year economic life of a project.

The costs to mobilize and demobilize construction equipment for a project is a costly part of any maintenance work. More depth below that required for the project provides a basin for sediments. That basin increases the interval of time between each maintenance operation and reduces the number of cycles for shoal removal in a 50 year period. The advanced maintenance depth at Big Bend provides an opportunity for lower AAEQ maintenance costs.

Maintenance Data. The estimated mobilization and demobilization cost of equipment is $860,400 for each maintenance cycle. The average shoaling rate for proposed bottom configuration is 80,000 CY a year or about 0.44 feet of uniform shoaling throughout the bottom area. That rate of shoaling results in over a foot of uniform shoaling about every 3 years.

Advanced Maintenance Analysis. The analysis assumes that the channel shoaling is at a uniform rate and accumulates about 240,000 cubic yards every 3 years. Advanced maintenance provides additional depth below the selected project depth of 41 feet. The extra depth provides a basin for shoaling to accumulate before impacting the project depth. The analysis is for depths of 1, 2, 3, and 4 feet with corresponding time intervals of 6, 9, 12, and 15 years, respectively, estimated between each maintenance cycle.

Table 9 summarizes the data use to develop and compare the total average annual equivalent (AAEQ) cost for maintenance. The estimated cubic yards removed with each depth grouping provides a basis for estimating each maintenance cycle cost. The total present value of each future maintenance occurrence within the 50 year economic life of the project is the basis for estimating the AAEQ cost of that work at each depth.

Initial construction of the project includes the advance maintenance depth as required overdepth dredging. The additional first cost to provide that initial depth for advanced maintenance is in table 9. The AAEQ value of that cost at each considered depth is also a cost factor in determining the least cost alternative.

The analysis in table 9 adds the AAEQ values for maintenance and additional first cost. A comparison with the AAEQ cost of $549,000 for no advanced maintenance indicates the added depth considerations are a less costly alternative. The least cost alternative of all the considered depths is 2 feet with an estimated total AAEQ value of $325,000. That depth has an estimated maintenance cycle every 9 years after project construction.

To add 2 feet of required overdepth for advanced maintenance increases the total economic cost of the selected project depth of 41 feet by $1,700,000. This increase results in an additional AAEQ cost as shown in table 9. An increase of $133,000 in the AAEQ economic cost is more than offset with the reduction ($357,000) in AAEQ maintenance costs from $549,000 to $192,000.

TABLE 9A

COST SHARING FOR ALTERNATIVE PLANS
(1,000's)

Project Feature	37 Feet	39 Feet	40 Feet	41 Feet	42 Feet	43 Feet
Base Project + Inner Channel						
Benefits	542	1438	1870	2179	2254	2324
First Costs	5736	7008	8028	8623	9136	10094
AAEQ Costs	449	548	628	675	715	790
AAEQ O&M Costs	485	485	485	485	485	485
Sub-Total AAEQ Costs	934	1033	1113	1160	1200	1275
Net Benefits	-392	405	757	1019	1054	1049
B/C Ratio	.58	1.39	1.68	1.88	1.88	1.82
Base Project + Inner Channel + East Channel						
Benefits	1846	2948	3406	3729	3810	3880
First Costs	6567	7890	8974	9698	10273	11398
AAEQ Costs	514	617	702	759	804	892
AAEQ O&M Costs	552	552	552	552	552	552
Sub-Total AAEQ Costs	1066	1169	1254	1311	1356	1444
Net Benefits	780	1779	2152	2418	2454	2436
B/C Ratio	1.73	2.52	2.72	2.84	2.81	2.69
Advanced Maintenance						
First Costs	1323	1808	1299	1700	2336	2472
AAEQ Costs	104	141	102	133	183	193
AAEQ Maint Savings	-233	-233	-233	-233	-233	-233
Total Project						
Total Project - Benefits	1846	2948	3406	3729	3810	3880
First Costs	7890	9698	10273	11398	12609	13870
AAEQ Costs	618	758	804	892	987	1085
AAEQ O&M Costs	319	319	319	319	319	319
Sub-Total AAEQ Costs	937	1077	1123	1211	1306	1404
Net Benefits	909	1871	2283	2518	2504	2476
B/C Ratio	1.97	2.74	3.03	3.08	2.92	2.76

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TABLE 9

ADVANCED MAINTENANCE ANALYSIS

Items	Amounts (000) by Advanced Maintenance Depths in Feet			
	1	2	3	4
MAINTENANCE CYCLES	6 yr	9 yr	12 yr	15 yr
Per Cycle: Cubic Yards	480	720	960	1,200
Cost	$2,271	$2,388	$2,484	$2,712
Present value 1/	$3,978	$2,454	$1,703	$1,299
AAEQ cost	$311	$192	$133	$106
ECONOMIC COSTS				
Net increase 2/	$575	$1,700	$2,911	$4,172
AAEQ net increase	$45	$133	$228	$326
TOTAL AAEQ COSTS	$356	$325	$361	$432

1/ Present worth value of all the costs for estimated future maintenance work over a 50 year project life at an interest rate of 7.625 percent.

2/ Net increase determined from an estimated base economic cost in table 5 of $9,698,000 for a project depth of 41 feet with no advanced maintenance depth requirement.

SELECTED PLAN

The selected plan was derived from three evaluations. One is the bottom configuration which is the result of model simulation for safe navigation of the Big Bend Channels and Turning Basin as shown on figure 10. The second is a depth analysis that selects a depth of 41 feet over the selected bottom configuration. The third is an advanced maintenance overdepth analysis which added a required overdepth for maintenance of 2 feet. The costs include an allowable overdepth of 1-foot for dredging inaccuracies. That completes the plan selection for deep draft navigation at Big Bend. Those navigation features are the most responsive to the planning objectives and provide for the most efficient use of the area's commercial facilities while minimizing the impact to the area's environmental resources.

NAVIGATION PLAN FEATURES

The plan has a number of individual features that underwent separate consideration to addresses the planning objectives, needs, and opportunities set forth in earlier sections of this report. Considerations in development of those features included environmental, engineering, and economic quality to select a plan for implementation of a navigation project at Big Bend. The resulting features are in subsequent discussions.

Entrance Channel. Improvements to the entrance channel include: (1) deepening to a project depth of 41 feet and (2) widening the bottom by 50 feet on the north side. The total bottom width is 250 feet along the 1.9 miles of channel. An advanced maintenance overdepth of 2 feet makes the required dredging depth 43 feet over the entire bottom width.

Widener. The existing wideners between the entrance channel and Hillsborough Bay Channel Cuts A and C remain unchanged. The widener at the junction of the Hillsborough Bay Cuts A and C appeared to need widening which was later found to be in error. No correction is necessary in that area as the channel markers correctly show the westerly limits of the widener. The depths and widths in that area are sufficient without any dredging.

Turning Basin. The southwestern edge of the turning basin needed expansion to turn the larger ships. The turning diameter in the basin is 1,200 feet. The depth in the basin is to be 41 feet with 2 feet of advanced maintenance to make the total required depth for dredging 43 feet. The expansion provides a safer transition for larger ships from the entrance to the inner channel.

Inner Channel. The inner channel bottom width of 200 feet remains the same but at a deeper project depth of 41 feet. An advanced maintenance overdepth of 2 feet makes the required depth 43 feet over that bottom width.

East Channel. The channel extends from the turning basin eastward at a project depth of 41 feet over a bottom width of 200 feet. An advanced maintenance overdepth of 2 feet makes the required depth 43 feet over that bottom area.

Berthing Areas. The existing berthing areas are 100 feet wide for coal and phosphate products and require deepening to fully utilize the entrance channel, turning basin, and inner channel project depths of 41 feet. The berthing area dredging is in the estimated cost for a project but is not a navigation feature included for cost sharing. The project sponsor is responsible for the costs to deepen the berths.

DESIGN

Project design involves the gathering of all necessary information related to an engineeringly safe, economically justified, and environmentally acceptable plan. Current laws and regulations provide environmental and economical guidelines which coupled with engineering experience enable plan formulation for an implementable project.

In the design for safety, vessel characteristics underway were a main consideration along with the channel bottom material. An analysis of existing and prospective vessel fleets helped identify potential usage problems or limitations with current conditions. Coordination with the sponsor, pilots, and local interests identified existing problems areas based on experience with navigating existing vessels on the waterway. Considering the existence of rock in the channel bottom and future vessel usage, the need for a ship simulation study was evident to aid in the design process and possibly reduce construction costs.

Model Simulation Studies. The Waterways Experiment Station (WES) did model simulation studies during 1993 and 1994 to consider the need for widening. The model conditions took into account the mean tidal range in the area of 1.8 feet and winds which impact primarily light-loaded vessels. Currents were a minimal consideration.

Design Vessels. The model results were for two design vessels. One was an integrated tug and barge (ITB) with a length overall of 760 feet, beam of 78 feet, loaded draft of 32 feet, and light draft of 12 feet. The other was a bulk carrier with a length overall of 740 feet, beam of 105.75 feet, and a loaded draft of 37 feet. Underkeel clearances of 1 to 2 feet were a consideration. The bulk carrier was single screw and used tug assistance at the entrance to Big Bend Channel and in the turning basin. The ITB was twin screw and had a bow thruster. Design winds were variable from the north averaging 15 knots.

Model Results. The WES report is in appendix C. Pilots, licensed to handle ships in the Big Bend Channel, assisted with the development and evaluation of the plans and design alternatives. The model included a channel depth of 40 feet below mlw which provided a reliable variance of +/- 2 feet for that design condition. The channel width of 200 feet was the main design concern for evaluation.

The model considered an additional width of 50 feet necessary for navigation. Testing looked a placing the width all on one side or an equal amount on both sides. testing in addition to the existing 200 feet. WES recommended the alternative of widening all on the north side (Plan B) of the channel. That is the selected plan for implementation.

Test results also recommended a larger widener between the entrance and inner channel on the southwestern side of the turning basin at Buoy 10. That change was to provide more maneuvering room and clearance for tug assistance in making that turn in the turning basin. That recommended modification also enlarged the turning diameter to a diameter of 1,200 feet.

The turn between C Cut on the main Tampa Harbor channel and the Big Bend entrance channel was also a problem for vessels. The turn caused vessels to swing outside the western bottom boundary of the main ship channel at the junction of C and A Cuts. Depths in that area where the ships leave the channel are not a problem and no groundings occur as a result. To avoid leaving the channel, the recommendation is to move the channel markers to the west and provide more channel width in that area.

EXCAVATION

The geotechnical analysis in appendix A indicates the new work dredging involves mainly sand, silt, clay, shell, and some rock in the excavation. Available subsurface investigations indicate a considerable amount of fine material comprising as much as 40 to 50 percent of the total project excavation. The selected plan is for a required dredging depth of 43 feet (includes 2 feet of advanced maintenance) over the enlarged bottom area of the existing channel. Removal to that depth involves the excavation of about 3,238,000 cubic yards (CY) of material. A 1-foot allowable overdepth for dredging inaccuracies could result in a gross yardage of 3,477,000 CY.

DISPOSAL

Disposal island 3D is the primary disposal area for all excavated material. The disposal process provides a natural separation of the fine material from the coarser material suitable for construction. Approximately 3.24 to 3.48 million cubic yards (CY) of material to be excavated is to go into the disposal area from initial construction of the selected plan. That quantity includes an excavation allowance of 1 foot below the required depth (project depth plus required overdepth for advanced maintenance) to allow for dredging inaccuracies.

The material is to go into the southern end of the disposal island. The weirs for overflow waters are on the northern end. The coarse material is likely to settle in the southern end along with 8 percent of the total volume that is likely to be fines. Estimating fines at 45 percent of total excavation volume, the remaining 37 percent is likely to move to the northern end near the weirs. Suitable construction material settling on the southern end is estimated at 2.0 to 2.2 million CY. 1.7 million CY is necessary for dike construction on disposal island 3D.

DIKES

Placement of 3.2 to 3.5 million CY of material into disposal island 3D is possible only with construction of higher dikes. Assuming no existing capacity is available on that island, a dike height increase of 7 feet is necessary to hold 3.7 million CY of material. The existing dike is at an elevation of 20 feet above mean low water. The additional 7 feet requires 582,000 CY of suitable construction material plus about 35,000 CY for dike repairs on the southwest corner. The repair is maintenance work and not a cost for the project. The repair is necessary before prior to any increase the height. The material on the southern end of disposal island 3D has an estimated 1.7 million CY of suitable material. Sufficient material is available on disposal island 3D to raise the dike height and make repairs.

Foundation conditions limit the ultimate dike height on disposal island 3D to an elevation of 40 feet above mean low water. Construction of the dike to that elevation requires about 3.34 million CY of suitable construction material. Dike repairs to the southwest corner require another 35,000 CY for repairs to the southwest corner. About 1.675 million CY of additional suitable material is necessary with the 1.7 million CY in 3D to obtain the maximum height. The most cost efficient source of material is from the dredging of navigation features at Big Bend. The material also needs to go into disposal island 3D to separate most of the fines from coarse materials.

WEIRS

Disposal island 3D has the potential to accommodate the material from the initial construction. The existing weirs are usable with some repairs. Costs are in the estimates to repair and raise the existing weirs consistent with dike construction for disposal of the Big Bend dredged material.

ENVIRONMENTAL CONSIDERATIONS

The selected plan considers the potential impact that construction and disposal activities can have on bird nesting and manatees in the area. To avoid impacts to bird nesting on disposal island 3D, the construction schedule is to exclude disposal operations during the bird nesting season from 1 April-31 August. The construction contract for dredging will include the following to protect the manatees:

- Standard Federal and State manatee protection conditions;
- Provision for a trained biologist, approved by the Fish and Wildlife Service and/or Florida Department of Environmental Regulation, to be aboard the dredge;
- No dredging at night during the winter manatee window with the use of a clamshell dredge to do the excavation; and
- Placement of propeller guards on the auxiliary vessels moving supplies and personnel between the dredge and shore.

Environmental interest indicated that Sunken Island was a higher priority than Whiskey Stump Key. However, the amount of suitable material available will likely determine the best plan. Filling the holes at Whiskey Stump Key raises the bottom depths to an elevation consistent with the existing bottom in the surrounding area. The higher bottom elevation creates an estimated 53 acres of habitat for the marine environment.

The use of the dredged material to benefit the environment has a high priority in the Tampa Bay area. The selected plan includes the placement of all dredged material onto disposal island 3D for raising the dikes. If suitable material is available after required dike construction, the excess would be available for improvements to the environment. Consideration at that time would determine the most feasible use of the material based on available authorizing legislation.

PRECONSTRUCTION PLANNING

Additional hydraulic and subsurface information will be obtained during preconstruction planning to more accurately define the conditions for construction. Upon completion of plans and specifications, a contract would be advertised and awarded for project construction.

CONSTRUCTION

Assuming funding availability, the estimated construction time is about 4 months. During that period after contract award, excavation and disposal is to involve approximately 3.2 to 3.5 million cubic yards of material to modify existing channel conditions. To the extent possible, the construction is to avoid the nesting season of migratory birds. If construction during the bird window is unavoidable, provisions satisfactory to the U.S. Fish and Wildlife Service and State environmental agencies would be made to accommodate any nesting pairs. Standard precautionary measures are to be taken for locating and minimizing possible impacts to any manatees that happen into the area during the dredging operations.

Project construction is expected to involve the following:

- Excavation of material from the project channels, turning basin, and berthing areas with placement of the material in disposal island 3D.

- Installation of appropriate navigation aids by the U.S. Coast Guard along the project waterways.

The estimated costs for the project anticipate the use of a hydraulic dredge with a cutterhead to excavate material for larger channel and basin conditions. The excavated material is to be pumped through a pipeline to disposal island 3D.

NAVIGATION PLAN FIRST COST

Table 10 contains the major items of the selected plan for navigation improvements at Big Bend. The excavation quantity is for construction of the required project depth of 41 feet plus 2 feet of advanced maintenance. Excavation of berthing areas to the same depths and bulkhead modifications to enable those depths are separate from the channel and turning basin dredging because they are sponsor costs. Attachment 3 of appendix A provides a breakdown of cost but does not include the bulkhead estimate. That estimate came from area interests. The dredging costs include a 1 foot allowable overdepth for dredging inaccuracies.

TABLE 10

SELECTED PLAN ESTIMATED TOTAL FIRST COST

ITEM	COSTS
Mobilization and Demobilization - Hydraulic Dredge	$861,000
- Dike Equipment	80,000
Excavation - Hydraulic Dredge with Upland Disposal	4,097,000
Berthing Area - Hydraulic Dredge with Upland Disposal	517,000
Aids to Navigation	438,000
Turbidity and Manatee Monitoring	87,000
Disposal Area Preparation - Dike construction	1,644,000
- Weir work	152,000
Bulkhead modifications - coal terminal	2,133,000
Preconstruction Engineering and Design	595,000
Construction Management	744,000
TOTAL FIRST COST	$11,348,000

OPERATION AND MAINTENANCE

A required overdepth for advanced maintenance increases the time between maintenance cycles to approximately 9 years. The disposal area for maintenance material is disposal island 3D. Higher dikes will be necessary to accommodate the maintenance material from Big Bend and other areas that use the island for disposal of shoal material such as the Tampa Harbor Main Shipping Channel.

Annual Shoaling. Dredged material from maintenance of the Big Bend Channel is to be placed in disposal island 3D. That island also has other shoal material sources besides Big Bend as discussed in appendix F. The other sources have an estimated potential shoaling rate which combined with Big Bend forms an annual estimate in the future as follows:

	Annual amounts in 1,000's		
3D Shoal Sources	1998	1999	2000-2047
Other Tampa Harbor projects	280	280	280
Big Bend project	80	80	80
Alafia River project	-	-	65
TOTAL	360	360	425

Based on the above annual shoaling rates, the estimated Big Bend portion ranges from 22.2 percent in 1998 and 1999 to 18.8 percent from the year 2000 into the future.

Disposal Capacity. An analysis of capacity in disposal island 3D is in appendix F. That island can accommodate all the construction material from Big Bend with an increase in dike height of about 7 feet assuming no existing capacity. However, that island is primarily a disposal area for maintenance material from the Tampa Harbor Federal project. Further increases in dike height will be necessary to enlarge the capacity for future maintenance of the harbor.

An increase in dike height of 20 feet provides an added capacity for future maintenance disposal. Determining that capacity involves an accounting for material coming from Big Bend not used in the dike construction as well as the existing capacity. The material not used in the dike construction reduces the capacity an estimated 1.56 million cubic yards (3,238,000 CY - 1,675,000 CY). The following is an approximate estimate of capacity within the disposal area after a 20-foot increase in dike height:

	Million CY
20 feet of dike --------------	8.6
Estimated capacity - 1997 ----	0.3
Dike material from inside 3D -	3.4
Big Bend material reduction	(1.6)
TOTAL CAPACITY ------------	10.7

The above potential capacity is for shoal material from Tampa Harbor and Big Bend. The Tampa Harbor project has an estimated shoaling for disposal of about 345,000 cubic yards a year. The Big Bend selected plan has maintenance of about 80,000 cubic yards a year. The estimated future shoaling rate of 425,000 cubic yards a year into disposal island 3D results in a life expectancy of about 25 years with the inclusion of half the annual maintenance from Alafia River. Any removal of material from the disposal island in the future for beneficial environmental uses can extend the life of that area even more. Big Bend, as part of the Tampa Harbor project, has a long tern management plan for disposal of shoal material from maintenance work.

ECONOMIC ANALYSIS

The economic analysis consists of an evaluation of the average annual equivalent (AAEQ) costs and benefits for the selected plan. The benefits come from the movement of coal, phosphate rock, and phosphate chemicals on the deeper depth channel of 41 feet. Development of the benefits is in appendix B. The AAEQ benefit from the movement of coal on deeper draft vessels is an estimated $2,179,000 and for the phosphate rock and chemicals $1,550,000. Table 11 provides the total benefit for all the channels and turning basin.

TABLE 11

SUMMARY COMPARISON OF SELECTED PLAN BENEFITS AND COSTS

ITEMS	41 Feet
AAEQ Benefits	$3,729,000
Costs - Interests and Amortization 1/	892,000
Maintenance: Channel shoals 2/	192,000
Navigation aids	3,000
Disposal area costs	124,000
Total AAEQ costs	$1,211,000
Benefit-to-cost ratio	3.1 to 1

NOTES:
1/ The total first cost ($11,348,000) plus IDC of $50,000 is the total economic cost for the project. That economic cost is then amortized over 50 years at an interest rate of 7.625 percent for the AAEQ cost for all channels, turning basin, bulkhead modifications, and berthing areas.
2/ Annual costs for maintenance to remove shoals include the excavation of material from the project channels, turning basin, and berthing areas with placement in disposal island 3D.

The AAEQ costs come from interest and amortization of the total initial economic first cost and maintenance of the project in the future. More detailed discussions are in the subsequent subheadings for different elements in the maintenance costs.

Channel Maintenance. The results of the advanced maintenance analysis show the most cost efficient overdepth for maintenance is 2 feet. Removal of about 720,000 cubic yards of shoal material with that overdepth dredging is estimated to occur about once every 9 years. The estimated maintenance cost for that removal is about $2,388,000. The present worth value of that maintenance cost every 9 years over the 50 year project life is about $2,454,000. The estimated average annual equivalent (AAEQ) cost for that removal is $192,000 as shown in table 11.

Dike Maintenance. Dike construction on disposal island 3D is essential for continued maintenance of the Federal navigation project for Tampa Harbor. The existing dike has little remaining capacity. The 1994 estimate of capacity was about 1,362,000 CY. Maintenance accumulations on the Tampa Harbor project without the Alafia River project is an estimated 280,000 CY a year. Disposal island 3D has about 5 years of maintenance capacity with existing dikes. An increase in dike height for more capacity is necessary by 1999 for continued maintenance of Tampa Harbor. Adding 7 feet of dike height for construction of the selected plan to deepen Big Bend will not significantly improve the disposal capacity in 3D for disposal of material from maintenance to remove shoals.

The construction equipment for raising the dike height on disposal island 3D can provide the 7 feet for the Big Bend work as well as additional height for the Tampa Harbor project. That saves the equipment mobilization cost for raising the dikes in two separate occurrences. If construction of the Big Bend deepening project does not occur before 1999, the Tampa Harbor project will likely require the higher dikes for maintenance. The likely increments for dike increases just for the Tampa Harbor project are 10 feet.

The first increment of 10 feet should be done as part of dike work for the Big Bend project. The first 7 feet is part of the Big Bend project costs and uses about 580,000 CY of material from within disposal island 3D. The estimated total material for dikes in the first 10 feet is about 1,108,000 CY which is available in disposal island 3D. Material from the Big Bend dredging will enable the construction of the last increment of 10 feet.

Dike Costs. The estimates of disposal area costs for the different increments of dike height have the same equipment mobilization and demobilization cost ($80,000) for dike construction. The estimated costs below exclude mobilization and demobilization, preconstruction engineering and design costs, as well as construction management costs:

Dike Increment	Costs (000)	
in feet	Total	Increment
7	$1,796	$ 0
10	3,411	1,615
20	9,893	6,482

An additional 10 feet of dike height above the existing height adds about 5.0 million CY of capacity to disposal island 3D. That equates to about 500,000 CY a foot. To raise the existing dike height 20 feet requires the use of an estimated 1.7

million CY of suitable material from dredging the Big Bend Channel improvement. That material is still within the disposal area after the initial dredging of the Big Bend Channel. Usable capacity for maintenance of the Tampa Harbor project with the 10-foot dike increase consists of about 1.5 million CY (3 feet x 500,000 CY a foot) plus the space where about 1.1 million CY came from inside 3D to raise the dike 10 feet. That total amount is about 2.6 million CY plus whatever existing capacity was in the disposal area at the time of construction.

The maintenance cost for the Big Bend Channel project would have a portion of the overall dike cost associated with disposal island 3D. Tampa Harbor with the Big Bend Channel project and without Alafia River has a total estimated annual shoaling of about 360,000 cubic yards. The Big Bend share(80,000 cubic yards) of that maintenance is about 22.2 percent. The extended life for use of the island to dispose of maintenance material from Tampa Harbor and Big Bend Channel is about 7 to 8 years (2,600,000 CY/360,000 CY a year).

The Big Bend project provides 7 feet of the initial 10 feet of dike increase above existing levels. The remaining 3 feet is for maintenance of the modified Tampa Harbor project to include Big Bend. The cost of that 3 feet is an estimated $1,615,000. The estimated preconstruction engineering and design costs along with the construction management costs are about $291,000. The estimated total is $1,906,000. The Big Bend share is an estimated $423,000 ($1,906,000 x 0.222) for future maintenance.

The second 10 feet of dike has an estimated dike and weir costs of $6,482,000. The estimated mobilization and demobilization, preconstruction engineering and design, and construction management costs are about $1,247,000. The estimated total is $7,729,000. The Big Bend portion of that dike cost for maintenance is an estimated $1,716,000 ($7,729,000 x 0.222).

The total maintenance cost for disposal area work includes the initial cost $423,000 for 3 feet of the initial 10 feet and $1,715,000 about 7 years later to raise the dike another 10 feet. The present worth value of $1,715,000 at an interest rate of 7.625 percent is $1,025,000. The total present worth value of the two increments is $1,448,000. The total capacity with the 20 feet of dike is about 10.7 million CY. That capacity provides about 30 years of disposal for 360,000 CY of shoaling material a year. The average annual equivalent (AAEQ) value of $1,448,000 over 30 years is about $124,000. That AAEQ value is in table 11 as the amount for the estimated project life of 50 years.

The economic appendix of the report includes a discussion of risk associated with the dependence of project justification on coal movements for Big Bend station. To summarize, the selection for mode of transport concerning coal is largely dictated according to the origin or selected source, which in turn is primarily driven by total acquisition and\or delivered cost(s) and quality (i.e., sulfur and ash content, Btu output, etc.). Given consideration of air quality standards, alternatives for regulatory compliance, cost, and quality of coal available both domestically and from foreign sources, it is highly probable that TECO will continue to import foreign coal. This determination is further supported by the location of TECO's generation plant with access to a major deep-draft waterway system which makes direct water transport practical and highly cost-effective with proposed improvements. Under such circumstances, the importation of foreign coal whether from Indonesia or South America is economically facilitated via self-propelled carriers of foreign registry due to scale and costs of associated vessel operations and is competitive with domestic barge operations such as GCT as demonstrated in the report appendix. As an example, Table B-15 and B-20 of the draft report and revised appendix illustrate that the lowest cost per ton for domestic barge services is $4.66 per short ton while review of Table B-26-b is $4.10 or less for service by self-propelled carrier for a waterway depth of 37.0 feet or greater. The relative spread for stated costs illustrate the advantage of waterborne transport with improvements (for further information concerning preceding discussion, refer to the economic appendix for Big Bend Channel).

PLAN IMPLEMENTATION

The sponsor, the Tampa Port Authority, is in agreement with the selected plan based on recent coordination. Implementation of that plan is dependent on further review within the U.S. Army Corps of Engineers and the Secretary of the Army's Office before going to the U.S. Congress for authorization as a Federal project. Authorization enables plan implementation with the sponsor providing the necessary non-Federal cooperation items. Non-Federal responsibilities include work that requires cost sharing and some that is 100 percent sponsor cost such as berthing area dredging, bulkhead modifications, and disposal area work. The Water Resources Development Act (WRDA) of 1986 established the formula for Federal and non-Federal shares of the estimated construction cost for the general navigation features of the selected plan.

IMPLEMENTATION AUTHORITY

Senate and House Resolutions requested the study of the Big Bend Channel in 1979. Those resolutions authorized the study and this report on the findings. The normal process for a Congressional study authorization is to send a final report back to Congress for project authorization first then request funding to implement the authorized project. That process takes time as the report goes to Congress for authorization in a Water Resources Development Act. Funding to construct the project normally occurs after Congressional authorization.

NON-FEDERAL RESPONSIBILITIES

Implementation of the selected plan involves specific non-Federal responsibilities. New cost-sharing in the Water Resource Development Act of 1986 requires the non-Federal sponsor to share in the costs of general navigation features (GNF). The GNF on the Big Bend project include the:

- Entrance, east and inner channels;
- Turning basin that connects the three channels; and
- Dikes and weirs for disposal of dredged material from initial construction.

Congress included dikes and weirs as GNF for cost sharing in the Water Resources Development Act of 1996. The sponsor's share of GNF for a project with commercial navigation benefits is:

- 25 percent in cash during the period of construction for a project depth of 41 feet and
- 10 percent over 30 years provided there is no non-Federal credit for the 10 percent.

Sponsor costs for relocations, lands, easements, and right-of-way are allowable non-Federal credits. The sponsor's credit cannot exceed 10 percent of the total GNF costs. Table 12 shows the total GNF costs to be $8,167,000 but no costs for any allowable non-Federal credits.

The berthing area dredging and bulkhead modification are 100 percent non-Federal responsibilities. Removal of shoal material on the existing non-Federal project to a required depth of 34 feet either prior to or during construction is a 100 percent sponsor responsibility and costs. The study identified no relocation nor cultural resources in the area that interferes with implementation of the selected plan. Standard cooperation agreement items of sponsor responsibility for project implementation are in the RECOMMENDATIONS section of this report. These items are standard for any non-Federal sponsor, but they do not all apply to the proposed project. Relocation does not apply in this case and table 11 has no cost for that item. The estimated items that apply are shown in that table.

FEDERAL RESPONSIBILITIES

The authorization of a Federal project for implementation incurs certain Federal responsibilities. Those responsibilities relate primarily to the general navigation features and aids to navigation. The aids to navigation are a 100 percent Federal responsibility. The Federal responsibility for initial cost of general navigation features is 65 percent for a project depth of 41 feet if the sponsor has no 10 percent credit. The non-Federal sponsor has no credits identified for the selected plan. That leaves the Federal percentage at 65 percent. The estimated current value of Federal cost is $5,309,000 (without the $438,000 for navigation aids). Table 12 shows the estimated values of Federal and non-Federal costs.

Once authorization of a project occurs, the Federal Government responsibilities also involve the following:

a. Subject to and using funds provided by the sponsor and appropriated by the Congress, the Government shall expeditiously construct the general navigation features of the project (including relocations or alterations of highway and railroad bridges and approaches thereto), applying those procedures usually followed or applied in Federal projects, pursuant to Federal laws, regulations, and policies.

b. To the extent possible, the sponsor shall be afforded the opportunity to review and comment on all:

- Contracts, including relevant plans and specifications, prior to the issuance of invitations for bids and

- Modifications and change orders prior to the issuance to the contractor of a Notice to Proceed. The Government will consider the comments of the sponsor, but contract award, modifications or change orders, and performance of all work thereunder (whether the work is performed under contract or by Government personnel) shall be exclusively within the control of the Government.

c. The Government shall operate and maintain the general navigation features (including any improvements made to Disposal Island 3D) of the project assigned to commercial navigation. Maintenance of the project is a Federal expense provided the sponsor furnishes the non-Federal responsibilities.

TABLE 12

SELECTED PLAN COST SHARING

ITEM	TOTAL COST (000)	FEDERAL SHARE (000)	NON-FEDERAL SHARE (000)
General Navigation Features (GNF)			
Channels and Turning Basin	$4,958	$3,223 1/	$1,735 2/
Environmental Monitoring	87	57	30
Dike and weir construction	1,876	1,219	657
Preconstruction Eng & Design	554	360	194
Construction Management	692	450	242
Subtotal, GNF Costs	$8,167	$5,309	$2,858
Features not Cost Shared			
Berthing Areas 3/	$517	0	$ 517
Preconstruction Eng & Design	41	0	41
Construction Management	52	0	52
Subtotal, Berthing Areas	$610	0	$610
Bulkhead Modification 3/	2,133	0	2,133
Navigation Aids	438	438	0
TOTALS	$11,348	$5,747	$5,601

NOTES:

1/ The estimated Federal share of general navigation features is 65 percent. The non-Federal sponsor has no estimated credit.

2/ Non-Federal sponsor cost is a 25 percent cash contribution plus 10 percent over 30 years for a total of 35 percent of the general navigation features .

3/ Berthing areas dredging and bulkhead modifications are 100 percent non-Federal expenses.

FLOOD PLAIN ASSESSMENT

Executive Order 11988 requires the Federal Government to avoid, to the extent possible, adverse impacts associated with the occupancy and modification of flood plains and to avoid direct or indirect support of flood plain development wherever there is a practical alternative. All lands within the Big Bend area current or potential supporting port facilities lie within the flood plain determined by a 100-year frequency flood elevation.

Navigation improvements at Big Bend would encourage the expansion of the existing cargo handling area. Alternative location of those facilities outside the flood plain is impractical. Also, development of additional facilities at alternative ports to handle prospective future tonnages would likely involve development within the flood plain at their respective sites.

COASTAL ZONE MANAGEMENT ACT

The Coastal Zone Management Act of 1972, as amended (PL 92-583) requires all Federal activities inside or outside a state's coastal zone to be consistent to the maximum extend practicable with the state's coastal zone management plan (CZMP) if the activities affect natural resources, land or water uses within the coastal zone. The State of Florida reviewed the proposed project and determined it is consistent with the State's CZMP.

COASTAL BARRIER RESOURCES ACT

The proposed new Federal investment decision for the Big Bend Channel navigation improvements does not include any recommendations which would result in any new Federal expenditures or financial assistance prohibited by the Coastal Barrier Resources Act (Public Law 97-348); nor were funds obligated in the past years for this project for purposes prohibited by this Act.

PUBLIC INVOLVEMENT

The Environmental Assessment (EA) contains letters and other pertinent correspondence that was received as a result of public and interagency meetings and coordination conducted during the study process. The draft report coordination with the public occurred between June 28 and July 29 of 1996. Comments and responses on the draft report are in the EA.

The main comment on the report was from the U.S. Department of Interior, Office of Environmental Policy and Compliance. The comment was over concerns by the Fish and Wildlife Service (FWLS) about the potential adverse effect on the manatee. The options to avoid adverse impacts were to avoid dredging during the winter months (November 15 - March 31) or provide a trained biologist, approved by the FWLS, to watch for manatees and require all service boats to have propeller guards. The latter option is a part of the selected plan for the project.

An informal public meeting on July 29 provided an opportunity for public comment. No adverse comments received from that public meeting on the draft report.

CONCLUSIONS

To consider resources in the area of the proposed improvement, plan formulation involved several alternatives. The no action plan provided nonstructural measures for future management and use of the existing facilities and navigation features to include continued maintenance of those features. Model simulation looked at the existing non-Federal channels and turning conditions to assess minimum changes needed for safe navigation. Selected plan conditions included the following:

- Entrance channel bottom width of 250 feet,
- Inner channel bottom width of 200 feet,
- East channel bottom width of 200 feet,
- An increase in the turn widener from the entrance channel to the inner channel, and
- Movement of navigation markers on the existing non-Federal channel.

Enlargement of the widener in the turn between the entrance and inner channels enables vessels to stay inside the bottom boundaries and also provides a turning diameter in the basin of 1,200 feet. Alternatives depths for deepening in all channels, the turning basin, and berthing areas ranged from 33 to 45 feet. Formulation considered measures to avoid or minimize impacts to significant environmental resources in the area. Plan implementation includes no dredging or disposal during the migratory bird season. Concerns about the manatee resulted in the following measure to be a part of dredging contract:

- Standard Federal and State manatee protection conditions;
- Provision for a trained biologist, approved by the Fish and Wildlife Service and/or Florida Department of Environmental Regulation, to be aboard the dredge;
- No dredging at night during the winter manatee window with the use of a clamshell dredge to do the excavation; and
- Placement of propeller guards on the auxiliary vessels moving supplies and personnel between the dredge and shore.

The no action plan provided a non-structural base condition without improvement but did not meet the planning objectives. The National Economic Development (NED) plan is for a project depth of 41 feet, an advanced maintenance depth of 2 feet, and an allowable overdepth of 1 foot. The NED plan is the selected plan which minimizes overall project costs and maximizes benefits in excess of costs. Based on the study findings, that plan has a total economic first cost of $11,348,000. The non-Federal share is $5,601,000 which includes berthing area dredging and bulkhead modifications.

Average annual equivalent (AAEQ) benefits are $3,729,000 from savings in transportation costs in the deep-draft vessel movements of coal, phosphate rock, and phosphate chemicals. AAEQ costs are $1,211,000 which includes interest and amortization of the total economic first cost and future maintenance of the channel and navigation aids. An interest rate of 7.625 percent provided the basis for discounting future benefits and costs. The benefit to cost ratio is 3.1 to 1. Sufficient estimated capacity exists in disposal island 3D for over 20 years of maintenance to remove shoal material from the selected plan.

The selected plan appears to provide sufficient material for dike construction. Excess material for beneficial use to enhance the environment would not be available at the time of construction. Direct use of dredged material from deepening and widening is not advisable due to the large amount of estimated fines in that material. To separate the fines from more usable material, placement in disposal island 3D is recommended to enable a natural separation to occur. Once that separation takes place, any excess material not needed for dike construction could be considered at a later date for beneficial use to enhance the environment. Consideration and recommendation of beneficial uses of that material is possible in the future under available Congressional legislation.

The Tampa Port Authority, the project sponsor, provided a letter in support for the selected plan. That letter is in appendix G. The Tampa Port Authority indicates full support for the project and is budgeting for their cost. The sponsor is aware of the cost sharing and required items of local cooperation for project construction. Construction will be completed under one contract. The sponsor has indicated willingness and financial support for the project.

The sponsor has also requested in a letter that the U.S. Army Corps of Engineers assume all applicable responsibilities for dredged material disposal facilities required for the Big Bend Channel project and the entire Tampa Harbor Project. This report serves as the decision document for the Big Bend Channel portion. The project cost sharing has been adjusted accordingly. The Project Cooperation Agreement will reflect the new responsibilities. A separate decision document will be prepared for the remaining Tampa Harbor portions and the existing cooperation agreement will be modified.

RECOMMENDATIONS

I recommend authorizing construction of navigation improvements and maintenance to non-Federal channels as a modification to the Tampa Harbor project in accordance with the plan selected herein, which is the National Economic Development Plan, with such modifications as in the discretion of the Commander, HQUSACE, may be advisable; at a first cost to the United States presently estimated at $5,842,000, with annual operation and maintenance costs of $255,000 to the United States.

These recommendations are made with the provision that the exact amount of non-Federal contribution shall be determined by the Commander, HQUSACE prior to project implementation, in accordance with the following required items of cooperation to which the non-Federal sponsor (Tampa Port Authority) shall agree to perform prior to implementation:

a. Provide, operate, maintain, repair, replace, and rehabilitate, at its own expense, the local service facilities in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

b. Provide all lands, easements, and rights-of-way, including those lands, easements, and rights-of-way required for dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features (including all lands, easements, rights of way, and relocations necessary for dredged material disposal facilities);

c. Accomplish all removals determined necessary by the Federal Government other than those removals specifically assigned to the Federal Government;

d. Provide, during the period of construction, a cash contribution equal to 25 percent of the total cost of construction of the general navigation features (which include the construction of land based and aquatic dredged material disposal facilities that are necessary for the disposal of dredged material required for project construction, operation, or maintenance and which a contract for the facility's construction or improvement was not awarded on or before October 12, 1996) for costs attributable to dredging to a depth in excess of 20 feet but not in excess of 45 feet;

e. Repay with interest, over a period not to exceed 30 years following completion of the period of construction of the project, an additional 10 percent of the total cost of construction of general navigation features depending upon the amount of credit given for the value of lands, easements, rights-of-way, and relocations provided by the non-Federal sponsor for the general navigation features. If the amount of credit exceeds 10 percent of the total cost of construction of the general navigation features, the non-Federal sponsor shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of lands, easements, rights-of-way, and relocations in excess of 10 percent of the total cost of construction of the general navigation features;

f. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the general navigation features for the purpose of inspecting, and, if necessary, for the purpose of operating, maintaining, repairing, replacing, and rehabilitating the general navigation features;

g. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any betterments, and the local service facilities, except for damages due to the fault or negligence of the United States or its contractors;

h. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total cost of construction of the general navigation features, and in accordance with the standards for financial management system set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 CFR, Section 33.20;

i. Perform, or cause to be performed, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous sub-stances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, and maintenance, repair, replacement, or rehabilitation of the general navigation features. However, for lands that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigation unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

j. Assume complete financial responsibility, as between the Federal Government and the non-Federal sponsor, for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features;

k. To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA;

l. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR, Part 24, in acquiring lands, easements, and rights-of-way, required for construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

m. Comply with all applicable Federal and State laws and regulations, including, but not limited to, section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army;" and

n. Provide a cash contribution equal to 25 percent of the total historic preservation mitigation and data recovery costs attributable to commercial navigation that are in excess of 1 percent of the total amount authorized to be appropriated for commercial navigation;

o. Enter into an agreement which provides, prior to construction, 25 percent of preconstruction engineering and design (PED) costs.

The sponsor furnishes the above assurances during the development of plans and specifications after the project has been authorized for construction.

In agreeing to the assurances, the sponsor incurs several obligations. The most prominent ones involve the responsibility for a cash contribution equal to twenty-five (25) percent of the costs for general navigation features prior to advertisement of the project for bids and the liability for cleanup costs of hazardous materials located on submerged project lands. At this time, there are no known hazardous or toxic materials located on the submerged project lands or in local berthing areas.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to Congress as proposals for implementation funding. However, prior to transmittal to the Congress, the sponsor, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded the opportunity to comment further.

for TERRY L. RICE
Colonel, Corps of Engineers
Commanding

JAMES A. CONNELL
LTC, Corps of Engineers
Deputy Commander